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EDITED BY

E. C. PERRY, M.A., M.D.,

AND

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VOL. LIII,

BEING

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NOTES ON DIAGNOSIS.

By P. H. PYE-SMITH, M.D., F.R.S.

THE conception of diagnosis, or discrimination, as a preliminary to treatment is altogether of modern growth. Ancient and mediæval medicine, and even the medicine of the seventeenth and eighteenth centuries, was almost confined to what we should now call treatment of symptoms. A patient's malady was called a fever, or a dropsy, or a palsy, just as the patient or his friends would apply these terms; they were scarcely technical, far less scientific. The same disease was named sometimes the measles, sometimes the smallpox; and a cough, a defluxion, or a rheum, interchangeably.

The Greek terms Pleurisy, Apoplexy, Podagra, Dysentery, meant only as much as "side stitches," "stroke," "foot-ache," and "bowel-complaint." And the same non-pathological significance attached to the Latin words, Pestis, Passio colica, Gonorrhœa virulenta.

The "principles of medicine" were traditional, and for the most part baseless conjectures about humours and temperaments, vital and animal spirits, elementary fibres, crudities and impurities of the blood, contractions and dissolutions of the nerves—mere words with no corresponding facts.

Diagnosis was for the most part impossible until morbid anatomy had been studied. Before then the only test of diagnosis was prognosis in the case of specific diseases. If a physician said a patient had smallpox or plague, and he recovered without a scar and without the disease spreading to others, the diagnosis was wrong; if the pustules or the buboes appeared, the disease bred true, and the diagnosis was right. But whether the seat of a disease was in the heart or the lungs, the

brain or the liver, was a mere dialectical dispute. It is true that the dead bodies of patients were frequently opened in the seventeenth century by Harvey, by Morton, and by many other physicians, including James Molins, whose MS. notes (1674-77) have been recently discovered by Dr. Payne, and printed by him in the twenty-third volume of the St. Thomas's Hospital Reports. The practice was continued in the eighteenth century, though perhaps with less zeal, and the records of Bonetus¹ and Morgagni may still be consulted with interest. But it was only when morbid anatomy was studied for its own sake by Meckel and Rokitansky in Germany; by Laennec, Bayle, Andral and Cruveillier in France; and by Baillie, Abercrombie, Carswell and Bright in England, that diagnosis became possible. As a rule, before the present century, the great majority of cases in the hospitals were not examined after death—only strange or singular cases; and strange and singular were the objects found. In many cases the first object was to ascertain whether the patient had died from natural causes or from poison. The examination never extended to all the viscera. There was no attempt at accurate independent description of their appearance, and post-mortem changes were confused with those produced by disease. The lungs were generally described as "rotten" or "black," the heart as large, the brain (when looked at) as soft or congested, the spleen as swollen or filled with black bile. The liver was generally "scirrhus," *i.e.*, hard; the heart contained "polypi" (post-mortem clots); the kidneys were usually called "pretty good" (unless a calculus was found), and the spinal cord, the testes, the adrenals, the pancreas, and the thyroid were seldom even mentioned. When chemical changes were observed, they were supposed not to cause but to be caused by the symptoms observed during life. Fever consumed the lungs in phthisis; dropsy dried up the liver; asthma dilated the heart, or the gout settled in the stomach. Hence, even after an autopsy, a diagnosis

¹*Sepulcretum sive Anatomia practica ex cadaveribus morbo denatis*: published at Geneva by Theophile Bonet in 1679; Morgagni's great work, "*De sedibus et causis morborum per anatomen indagatis*," which included many older observations of Valsalva, was published in 1761.

of "decline," or "paralysis," or "asthma," or "dropsy," meant no more in the mouth of the physician than in that of the patient.

Now, when we make a diagnosis, we affirm either that there is only functional disturbance present, or that there is poisoning by a demonstrable agent like lead, or that the body is invaded by an infection and is capable of distributing the same infection further; or, lastly, that there is a certain definite change in the structure of one or more of the organs. And we discriminate further still: for we affirm either that the functional disorder belongs to a recognised recurrent group of correlated symptoms, or that the poison is a known metal or chemical compound, or that it is produced by a known living organism, or that it is predicable in its effects though not fatal in its nature; or, lastly, that the organs which are injured or altered would, if seen, present certain structural and chemical phenomena to the naked eye, to the microscope, and to analysis. Such diagnosis admits the practical confirmation of a prediction which is verified by the event. It is no mere opinion, to be sustained by the dialectic skill which often makes the worse appear the better reason; it is an affirmation based on past experience, and verifiable or refutable by future experience.

Diagnosis, therefore, is true knowledge—knowledge that can predict and is proved by the event. A diagnosis which will not stand this test is worthless. The discoveries of Laennec would have been useless, the stethoscope would have remained a mere toy, if the great French physician and his successors in Vienna, London, and Dublin, had not been morbid anatomists as well as clinical physicians. The fact that some patients with dropsy had albumen in the urine was known before Bright, and was "explained" as being an "effort of nature" to get rid of the extravasated serum by the kidneys. Bright's merit was in discarding explanations and going into the deadhouse to investigate. It was long before the truth of Harvey's prescient words were understood: *Sicut enim sanorum et boni habitus corporum dissectio plurimum ad philosophiam et rectam physiologiam facit, ita corporum morbosorum et cachecticorum inspectio potissimum*

ad pathologiam philosophicam et ex pathologia usus et ars medendi. (Exercitatio anatomica ad Riolanum prior.)

Before diagnosis was seriously attempted, prognosis was mere guesswork, and treatment was in most men's hands guided by baseless dogmas, of which the last, and by no means the most absurd, still survives as the so-called system of homœopathy. In their hands it did harm, in those of the intelligent minority it was feeble, tentative, and more useful in preventing mischief than in doing good.

Now, our general prognosis follows our diagnosis with something like certainty, a certainty based on experience of the natural tendency of the disease to death or recovery under certain recognised conditions of age, extent, severity, and complications. The individual prognosis is still uncertain and depends on appreciation of slight signs and presages, combined with large experience, and the intuitive judgment that can neither be acquired nor imparted. Still this "unscientific" Hippocratic prognosis, even at its best, is only an immediate forecast for a very short span of future time, and even at its best it is very uncertain. It may sometimes seem that nurses and other persons experienced in watching the sick, but without pathological knowledge, make better prognoses than a skilled physician. But this is not really the case. A mother changes her conviction of her child's fate twenty times a day, but was always sure it would get better (or would die) when the event has come. An experienced nurse's hits are all marked and remembered while her more numerous misses are unheeded or forgotten. I remember a case when a young physician of considerable knowledge and small experience was discussing with an old apothecary of no skill in pathology and of enormous experience, whether a patient should take such-and-such diet and whether he might be allowed to smoke, and the questions were settled by his dying as they stood on each side of his bed.

As with prognosis, so with treatment and prevention of diseases. There is still room for experience and for judgment, for the incommunicable insight that discerns what is possible and what is not; for the tact that varies a prescription while keeping its object

in view ; for the integrity, force, and simplicity of character that inspire hope and constrain to implicit obedience. But only impostors prescribe without examination, or talk of a patient's "constitution" without having seen his urine. The popular belief is that the patient knows what is the matter, and the doctor knows the cure for it ; and every one of us who treats symptoms without making a diagnosis is helping to perpetuate the mistake, to degrade our profession, and to encourage quackery in general and the sale of advertised nostrums in particular.

Since, then, diagnosis is essential to the safe or useful practice of medicine, are there any rules that may help us in this most interesting and important study ?

In the first place, we must never be satisfied till we have made a diagnosis ; until that is done nothing is done. And when we have made it, we must *write it down*. A mental and even a verbal diagnosis is apt to be more or less vague, and to oscillate between two conclusions. Moreover, when the true nature of the case becomes apparent, we are unconsciously led to believe that this was our diagnosis from the first. A boy who is afraid of a fall will never learn to ride, and a man who is afraid of committing himself to a definite opinion will never gain the power of making either diagnosis or prognosis. Every time our deliberately formed opinion is verified by the event, we gain in experience ; every time it is corrected or reversed, we gain still more ; but a case on the nature of which we hesitate to the last profits us little.

Again, a diagnosis must not only be definite, it must be based on careful examination. Rapidity will come with time and experience, but should not be our aim. The greatest mistakes are usually made from over-confidence, from want of painstaking in examination. We hear of Sir Astley Cooper that, passing through Job ward (where medical and surgical cases were then lodged together), he noticed a thin, anxious-looking man and asked what was his disease. On being told that it was undecided, he said, "Depend on it, he has stricture of the œsophagus." This was no more than a shrewd guess, through it turned out a true one. So, too, we may see a middle-aged patient with the gutta rosea, the stigmata, the sallow tint, the furred tongue, the

thin lips and the swollen abdomen of the dweller in Hogarth's gin-lane, and you may "diagnose" cirrhosis of the liver at a glance. This is too easy to boast of, yet such a case has before now turned out to be not cirrhosis but cancer.

There are two ways to make a diagnosis. One is by observing the aspect of the patient, the circumstances of his life—his age, birthplace, occupation and habits—the way he lies in bed, the way he speaks or coughs, and the story he tells of his illness. After but little experience we learn thus to recognise phthisis and cardiac disease, bronchitis and enteric fever, rheumatism and insular sclerosis, almost as soon as we see the patient; but though usually right enough, such diagnoses must always be followed by the routine examination of all the organs, or we shall before long make some terrible oversight.

The other plan is to ask for no history, to form no preliminary opinion, but to go carefully and methodically through the whole routine prescribed in modern forms for "taking cases." It is even desirable (for beginners at least) not to try to combine the results of percussion and auscultation, of palpation and inspection, until the physical examination is completed. Then, if consonating râles go with dulness, or a water-hammer pulse with a diastolic basal murmur, we have the confidence produced by harmony of indications. But if, because there is flattening and deficient resonance under one clavicle we are prepared to hear bronchial breathing there; or, still worse, if because a patient is pale and thin and coughing, we listen expecting to find the physical signs of phthisis, we are prejudicing the court of our judgment before it has the evidence on which to decide.

Here I would enter a *caveat* against the practice we are all apt to drop into of mixing up the recognition of physical signs with the recognition of lesions of which they tell. A "regurgitant murmur," a "hydrocephalic cry," a "pneumonic râle," are examples of this confusion of language which, as is commonly the case, leads to, if it does not spring from, confusion of thought.

Scarcely less unfortunate is the habit of describing the sounds heard on auscultation of the chest by arbitrary comparisons. Those made by Laennec of cardiac murmurs to the noises

produced by bellows, files, saws and oboes, may be justified by precedent, although the variations in quality so indicated are of no practical moment; but when new names are coined in private mints it is to the confusion of serious medical study. All that is essential for the diagnosis of valvular lesions is the seat and range of a murmur and its exact rhythm, the latter sometimes a point of much difficulty, on which increasing experience diminishes confidence. All that is essential for diagnosis in auscultation of the lungs is recognition of the "tubular" as distinct from the normal respiratory sound, the distinction between "dry" or continuous sounds and "moist" or interrupted ones; the recognition of a pleuritic rub as distinct from either (again a task on which good auscultators sometimes differ), and the recognition of the presence or absence of "tone" which makes the difference between so-called "musical," "bright," "clear," "metallic," "crepitant," or "consonating" râles and those which are devoid of this quality of tone. The last is as important and fundamental a distinction as that between "bronchial" and "vesicular" breath sounds, or between dulness and resonance on percussion, and yet we often read accounts of cases and even treatises on auscultation in which with abundance of painful and arbitrary epithets, this essential point is left undecided.

Of the two methods of diagnosis above described the one is that in use up to the beginning of the present century. Its strength lies in natural power of observation, shrewd insight, and judicial instinct. Its aim is purely practical, to guide prognosis and treatment. Its conclusions are pathological rather than anatomical, and general rather than minute. When genuine, it is the more striking and brilliant method, but it may be counterfeited by inexperience and idleness. It was the method practised by Heberden and by Graves, and was carried to a high degree of perfection by the late Sir William Gull. The other is the method which has been rendered possible by the invention of the stethoscope and the ophthalmoscope, the laryngoscope and the hæmacytometer. Its strength lies in familiarity with physical and chemical methods of investigation, in skilful use of instruments, and untiring power of taking pains. Its aim is the precise ascertaining of

facts, physical, anatomical, chemical, and even histological, and becomes more and more ambitious as morbid anatomy becomes more accurately known. It is a slow but a very sure method, and is seen to the best advantage in a public hospital provided with chemical, physiological, and bacteriological laboratories, and worked with the help of skilled assistants, house-physicians and medical registrars, to whose credit the diagnosis of an obscure case is often due. It is the method introduced by Laennec in the second decade of the present century, and now carried out in all the great schools of medicine at home and abroad. It was taught and practised by the late Dr. Murchison and by Sir William Jenner.

Both methods of diagnosis are necessary. If we depend solely on probabilities, and history, and aspect we shall often be treating not the disease but the symptoms. If we depend solely on the result of physical and chemical examination, we shall often be led widely astray and overlook the plainest indications of disease. Even the ancient physicians used the objective symptoms which are conveniently though arbitrarily called physical signs, whenever they could. The urine was assiduously inspected in the seventeenth century, though to no more purpose than the Chinese physician who feels his patients' pulse; and the nature of the expectoration, the heat of the skin, and the colour of the face, are just as much physical signs as the presence of albuminuria or the absence of a knee-jerk. Our increased means of investigation has given us vastly increased means of diagnosis, but we must observe with judgment as well as with diligence.

There were once two physicians in the same medical school who exemplified the need of both methods. The one was the philosophical observer who could recognise diatheses by the patient's smell and determine the presence of cardiac disease by inspecting the ears, but would sometimes overlook a large vomica or a pulsating tumour. The other was all for facts and the microscope, and while excellent in discovering what could be discovered by physical examination, failed to recognise a well-marked case of Addison's disease.

The truth is that we must use both methods. When we first see a patient we are told more or less relevant and more or less accurate particulars of his present illness and previous habits; and even without this prejudice we cannot help from the age, sex, and general aspect of the patient, his position in bed, his expression of face, his colour, voice and manner, forming a general judgment of the case and even guessing at a diagnosis. But when we come to examine the several organs we do well to forget these impressions and all the probabilities of the case and to concentrate our attention on the individual facts. Then, when we have found all that such investigation can tell us, we return from his organs to the patient and his general symptoms, and determine the meaning of the several "signs."

So far from minute examination interfering with sound judgment, judgment is only sound when it is based on the complete evidence afforded by minute examination.

A hurried diagnosis can never be complete and can seldom be true. The first glance tells us something, but never tells us all. No doubt we have often to form a prognosis and adopt treatment in cases of urgent emergency; but in such cases we must recognise that our diagnosis is only superficial and temporary, and must be content to obviate any pressing and dangerous symptom. It is very seldom that there is not time to ascertain the temperature, if only approximately by the hand; to auscultate the heart and the apices of the lungs; to pass the hand over the abdomen; to look at the pupils and the tongue, and roughly to test the urine. In cases which allow of this degree of examination a preliminary diagnosis is always possible, and a second visit will complete what is lacking. Symptoms which then assumed undue prominence have subsided, others which we overlooked are discovered, and the duration of the illness (usually understated), the habits of the patient (usually misstated), and his ordinary aspect and complexion are ascertained to be very different from what we supposed.

When a case is not clear at a first or even a second visit, we shall do well to content ourselves with the restricted but useful diagnosis which only refers the patient's malady to a

definite group. It is a case of dropsy, without our being certain whether the heart, the kidneys, or the lungs are primarily in fault. It is jaundice, it is paraplegia, or hemiplegia, or fever, or Bright's disease. Such diagnosis is sound as far as it goes, and naturally leads to greater precision until we can assign the exact seat and nature of the lesion. It was said of Dr. Cholmeley, physician to Guy's Hospital from 1804 to 1837, that, although he never learned the use of the stethoscope, yet it was very rare for a disease which he had fixed in the head, the chest, or the abdomen to be found after death in either of the other "great cavities of the body." This seems a modest degree of accuracy to aim at, but it is sometimes as much as we can reach even now, particularly in the case of children.

In difficult and complicated cases one is often embarrassed by the multitude of facts, the family history, the patient's own experience, his occupation, his appearance, seeming to point in different directions, and physical examination failing to offer a clue. It is then that the man of natural parts and trained experience sees what are the essential and what the accidental points. As Dr. Fagge once remarked to me, "if we are to make any diagnosis in so obscure a case as this, we must neglect some of the symptoms." It is knowing which to hold by and which to neglect that makes success in diagnosis. When history, aspect, general symptoms and physical signs all point to the same conclusion, diagnosis is easy and satisfactory. When this is not the case, we must be content with a tentative conclusion, wide enough not to exclude possibilities which may become certainties as the progress of disease continues. Or we may reach an alternative, and by keeping in view the two most probable diagnoses may find one or the other justified by future events.

When, after making a diagnosis to the best of our ability, we do not find the progress of the case to be what we expected, it is well to make a fresh and complete examination of the patient with as unbiassed a mind as possible, and often some new symptom will be discovered which before was overlooked or unappreciated.

In obscure cases, it is well to remember that common things most commonly occur, that it is more likely that some unusual symptoms are masking a familiar disease than that there is any very rare or unexampled case before us. To recognise such unusual cases, and open up new fields for diagnosis, is the work of such unusual insight as first discerned "melasma supragenale," or a "cretinoid condition in adult women." Fortunately the complication of independent diseases of which patients talk is very rare. In the great majority of cases we can identify one as the primary lesion, and the others as dependent upon it. It is seldom that cerebral tumour occurs in a patient with Bright's disease, that a consumptive is attacked by pneumonia or enteric fever, that gonorrhœal synovitis and gout, cancer and tubercle, or cardiac disease and leuchæmia exist in the same patient; and such cases, when they occur, are not the most difficult to unravel.

When a case is concluded by the death or recovery of the patient, we should always make an epicrisis, comparing our original written diagnosis with the event, and impartially judging how much we might have discerned with greater care, and how far our forecast has been verified by the event. As Addison said in his last clinical lecture: "He is the best physician who makes the fewest mistakes." We all make mistakes, and some cases are so obscure that they do not admit of a reasoned diagnosis; so that if we hit on the solution of the problem it is only by a lucky guess. But in most cases our failures are due to want of care and accuracy in examination. Frequent auscultation is not only tedious and troublesome to the physician but often distasteful to the patient, and the use of the ophthalmoscope, the laryngoscope, the hæmacytometer, and the test-tube takes up much time. But neither we nor our patients are safe if we fail to repeat such observations at regular intervals.

In forming a diagnosis it is well to start from some one important and certain symptom: a tumour, an abnormal sound, paralysis or spasm, hæmoptysis, jaundice, dropsy, or albuminuria. Pain and all other subjective symptoms, and common symptoms

like constipation, swelling of the ankles, backache, or pallor, are of little service.

We are much helped in further diagnosis by our knowledge of morbid anatomy. If every organ were liable to every disease, we should never come to the end of possibilities ; but we know that each organ has only a certain number of possible or probable lesions. Hence it is that the deadhouse is the high-way to diagnosis. So strictly are certain morbid processes confined to certain parts that an apical affection of both lungs is almost certain to be tuberculous, and meningitis which affects the vault of the brain is almost certain not to be tuberculous ; while in the case of many cutaneous affections, eczema, psoriasis, scabies, lupus erythematosus, and erythema nodosum are often clearly recognised by their distribution alone.

. We must beware of making diagnosis rest on probability. Thus, it does not follow that the abdominal pain of which a plumber complains is lead colic, even though he has a blue line on his gums ; he may have a strangulated hernia. A history of syphilis does not negative the diagnosis of psoriasis or hepatic carcinoma. Gonorrhœa does not protect a man from rheumatism nor intemperance from cancer. We must recognise scabies when we find it in a private patient, lues which is not venereal, and dyspepsia potatorum or alcoholic neuritis in refined and well-bred women. We may see variola where the mode of contagion cannot be traced, plumbism with no discoverable source, writer's cramp in persons who do not appear to have written more than usual, whooping-cough caught by old men from their grandchildren, and osteo-arthritis in patients six years old.

It is important not to push diagnosis beyond due limits in making official returns of cases. We can assert confidently that a patient is suffering from disease of the heart, but to say whether there is narrowing as well as leaking of the mitral valve, or whether there is adherent pericardium or fatty degeneration is sometimes impossible. We are sure that he has Bright's disease, but we often cannot say whether the kidneys are more affected by tubal or by interstitial disease. A certificate of death from

apoplexy is certain and valuable, but if a return is made of "cerebral hæmorrhage" without an examination after death, the inference is at most a probability and introduces confusion and fallacy into medical statistics. So, again, paraplegia is often a much more creditable return to make than a more pretentious anatomical diagnosis which, without an autopsy, is in many cases a mere guess. Less harmful because less misleading are vague and meaningless diagnoses, such as "debility," "cardiac failure," and "exhaustion"; but if returned alone they are useless for every purpose, scientific or practical, and if returned as "secondary causes" of death after such entries under a primary cause, as enteric fever, pneumonia, heart disease, or cancer, they are superfluous, and, in the proper sense of the word, impertinent. It is to be wished that the Government authority would instruct those who fill up death certificates to state whether or no an autopsy was made, and also to use such clinical diagnoses as jaundice, epilepsy, ascites, and general dropsy, when the exact cause of these morbid conditions is not clear.

In assurance practice, the returns of death in the case of those assured, and also in the case of their immediate relatives, are frequently useless from both of these causes—vague generalities and unreal precision. The word pneumonia is often used to denote not only the acute febrile disease, but every kind of inflammatory disease of the lungs, including phthisis itself. Congestion, again, whether reported of the brain, the lungs, or the liver, is a diagnosis which is no diagnosis. Active congestion apart from inflammation may, broadly speaking, be said not to exist, and passive or venous congestion is always secondary to some more important disease of the heart or lungs or blood-vessels.

To speak now of particular diagnosis, that of diseases of the nervous system is confessedly the most difficult. Great advance has been made in our knowledge of the pathology of these regions. The determination of the exact anatomy of cerebral hæmorrhage by Charcot and his colleagues, the discovery of the cortical motor centres, the invention of the ophthalmoscope by Helmholtz, the discovery of the paths of conduction and secondary

degeneration in the cord, have marvellously extended the knowledge possessed by Romberg or Marshall Hall fifty years ago. During this time few important additions to the catalogue of diseases of other organs have been made, but here we find locomotor ataxia, pseudo-hypertrophic paralysis, bulbar paralysis, tetany, Landry's paralysis, insular sclerosis, aphasia and its anatomical seat, peripheral neuritis, lateral sclerosis with its complications, Jacksonian epilepsy, Thomsen's disease, syringomyelia, Friedreich's ataxia—all diseases unknown by name in 1850 and all but unknown by their symptoms, yet now accurately defined, their seat and even their proximate causes ascertained and their diagnosis during life made by students every day. Unfortunately the same causes which so long delayed their discovery still hinders rapid advance in the certain recognition of these interesting lesions. These are: first, the extreme duration of most of them, so that the majority of the cases we see and diagnose pass from our knowledge before their end in either recovery or death; secondly, the trouble and difficulty of making a complete post-mortem examination of the peripheral nerves, cord, or even of the brain; and, thirdly, the need of special methods of hardening and staining before some of the most important anatomical changes can be recognised. A secondary inconvenience due to the last fact is that the physician who is familiar with the clinical features of the case is apt to forget them or even the case itself before the time when he may ascertain whether his diagnosis was right or wrong.

In obscure nervous cases, the gradual and tentative method is usually the surest. The first point is to detect or put aside the existence of intentional deception, of malingering on the patient's part. This is seldom difficult if suspicions are once aroused; mistakes are made by one's assuming as constant the good faith of the patient. The second point is to decide whether the disease is functional, including under that term all that is called hysterical, and is not deliberate wilful deception. The predominance of sensory over motor symptoms, the completeness of hemiplegia, the absence of incontinence of urine and of other motor symptoms, the early advent of contraction, are some of the general characters

that help us. We must remember that hysteria is far from uncommon in boys from puberty upwards, though it is more often mixed with malingering than in girls of the same age, and that true hysteria may exist along with organic and fatal disease of the brain or spinal cord.

Apart from functional disorders on the one hand and structural on the other comes an important group which we may call toxic. It includes delirium and coma from alcohol, poisoning by opium, belladonna, lead, and other chemical agents, diabetic coma and uræmic convulsions. It is only when, for instance, in a case of paralysis we have put aside shamming, hysteria, and "intoxication" (in the wide sense of the term as employed by French writers), that we can begin to assign the seat of the organic lesion to the encephalon, the cord, the peripheral nerves, or the muscles themselves.

In pulmonary cases, rapid breathing, orthopnœa, cyanosis, action of the alæ nasi, and other movements of forced respiration, are sufficient indications of dyspnœa apart from physical signs. When a patient who is neither an infant nor aged is seriously ill with bronchitis, we look for some complication or primary lesion, particularly tubercle and Bright's disease. Among the physical signs trust first to auscultation, next to percussion, then to movements of the chest and tactile fremitus, and lastly to voice-sounds. Do not expect many signs of bronchitis, or emphysema, or asthma, or pulmonary cedema. Trust to combination of signs, and beware of exaggeration; the common mistake is to call loud healthy breathing "harsh," harsh breathing "bronchial," and tubular breathing "amphoric." Be awake to the real difficulty of distinguishing pleural effusion from pulmonary consolidation on the one hand (particularly in children), and from a thickened and cedematous state of the pleura with fatty or dropsical chest-walls.

In cardiac diagnosis, admit that fairly debateable signs are far more common than in the lungs. A to-and-fro sigmoid bruit or a præ systolic murmur are easy enough to be sure of, but in many cases we do well not to be over confident. The sounds which seem so plain to-day may be changed or absent to-morrow, and

good auscultation will put different interpretations on what is presumably the same acoustic perception. Changing a patient's position from sitting to standing or lying down is often a great help. The seat of the impulse is a most valuable sign, the extent of cardiac dulness a difficult one; to obtain it time and care are needful, and it is necessary to mark it out and correct the outline until we get it exact. The examination of the pulse should always go with that of the heart. Do not forget to allow for excitement which may produce not only a frequent but an irregular action of the heart with a temporary murmur. Estimate the tension or resistance of the pulse before examining the heart or the urine.

In abdominal cases overcome the contraction of the muscles not by force but by taking care that your hand is warm, and by gently increasing the pressure of the whole palm during expiration. Use bimanual pressure on the flanks in abdominal, rectal, or vaginal examinations. The spleen can always be felt when enlarged if carefully sought, but no organ varies so much in its physical relations. Extent of liver dulness is a very imperfect guide to the size of the liver; apart from being pushed down, the organ is often pushed forwards so as to bring much of its upper surface in contact with the front wall of the abdomen, and in other cases falls back, and thus a large liver may give a narrow zone of dulness. Do not forget that the testes are abdominal viscera which have come down so as to be more readily examined than the rest; by neglecting them we lose what is sometimes decisive evidence of tubercle or of syphilis. In the interesting and often difficult diagnosis of abdominal tumours do not forget the elementary diagnosis between tympanites, ascites, and obesity, nor the existence of parietal growths and phantom tumours, nor the possibility of a distended bladder, a pregnant uterus, or an extra-uterine foetation.

Remember that the distinction between medical, surgical, and obstetric cases is not recognised by nature; think of the uterus and ovaries in every female case, and "surgical" diseases of the joints and bones in every case called rheumatism or rickets. Distinguish the popular use of "rheumatism" to denote any

ache, and of "gouty" to conceal professional ignorance, from the accurate meaning of rheumatic and gouty as the adjectives of two definite diseases. In children recognise rheumatism more by fever, cardiac lesions, subcutaneous nodules and chorea than by synovitis. Remember that gout is podagra, and be cautious of the diagnosis where there are no tophi and the hands and feet are unaffected. Recognise gonorrhœal synovitis by its distribution, its obstinacy, and the characteristic sclerotitis. Think of osteoarthritis as arthritis deformans, or "crippling rheumatism," and never use such misleading expressions as rheumatic gout.

In the diagnosis of diseases of the skin, insist in the case of men and of children on seeing the whole of the surface; and never give a final opinion on a case seen by artificial light. Rashes invisible in children who are brought to you on a cold day become manifest when you see them warm in bed. Never forget the possibility of factitious eruptions; look carefully for causes of irritation, in vermin, in clothes, in fire, sun, dust, and the accidents of many handicrafts, but also in the too free use of soap and water, and in the continuance of an application after the original complaint has been cured. First make out the primary lesion, and trace it then to its natural or distorted evolution. Next determine the localization, and pay only subordinate attention to the history and circumstances of the patient. Give every case a name, but be content with what is sufficient for the nonce—as, for instance, with such terms as erythema, syphilis, tinea, eczema, lichen, purpura, sycosis, or even superficial dermatitis, recognising that you will be able to add appropriate adjectives and thus define your diagnosis more accurately on a second or third visit. Never admit such hybrid names as syphilitic lupus or psoriasis.

CASE OF EPITHELIOMA OF THE NECK PROBABLY ARISING IN A RELIC OF ONE OF THE BRANCHIAL CLEFTS.

BRANCHIOGENIC CARCINOMA OF VOLKMANN.
TWO OPERATIONS. RECURRENCE. SPONTANEOUS
DISAPPEARANCE OF THE GROWTH.

By

W. H. A. JACOBSON, M.CH., AND S. B. DE MESQUITA, M.D.

THIS case possesses a two-fold interest, (1) as illustrating a variety of malignant growths which has attracted but little attention in this country; and (2) because the growth, an undoubted epithelioma, after reappearing twice and assuming characters which pointed to acute malignancy and speedy termination of the patient's life, disappeared entirely.

Mrs. S., æt. 46, was sent to me by Dr. de Mesquita, of Highbury, December 9th, 1896, with a swelling about the size of a small orange in the left submaxillary region. This reached backwards to the angle of the jaw and down into the anterior triangle as far as the anterior border of the sterno-mastoid. The outline was irregular on the surface, and ill-defined at the circumference. Though possessing some mobility on the adjacent parts, when handled firmly it gave the impression that it was becoming adherent. No fluctuation could be made out at any spot, though there was a soft elasticity present which ought, when taken with the ill-defined outline, to have suggested to me the possibility of a vascular new growth. The skin over the swelling was not adherent. There was no tenderness or heat. The patient stated

that there had been a swelling there for fifteen years, but the husband was certain that "something had been there" ever since he made his wife's acquaintance, *i.e.*, for fully twenty years. Up to the end of August, 1896, the swelling had caused no trouble; at this date it suddenly increased in size and became rather painful, the pain being especially referred to the upper part of the chest, and to the left ear. The patient soon after consulted Dr. de Mesquita, who, finding two carious stumps in the lower jaw of the same side, and believing the swelling to be glandular, advised their extraction. Their removal was not, however, followed by any relief or diminution in the size of the swelling, and as this was thought to be elastic or semi-fluctuating in the centre, an anæsthetic was given and an incision made deeply, but without result. To the knife the structure of the growth seemed quite hard and almost cartilaginous. From the position of the swelling in the left submaxillary region, the history of irritation in one of the structures supplying the submaxillary group of lymphatics, and the apparently clustered outline, I also looked upon the case as one of chronic enlargement of lymphatic glands commencing to caseate, and so resisting treatment. Two facts in the case should have prevented this mistake; one the very long existence of the swelling. This difficulty occurred to me, but it appeared possible that from the unhealthily anæmic, pasty aspect of the patient gland trouble of a like nature had occurred during adolescence, subsided in part, only to be lit up again by some recent inflammation in the septic contents of a carious stump, or by the invasion of ordinarily inflamed lymphatic glands by the bacilli of tubercle.

As is usually the case in instances of difficult diagnosis, there was another point which if properly insisted upon would have pointed to new growth—this was the consistence of the swelling when cut into by Dr. de Mesquita. That, however, did not come to my knowledge until nearly a year after I first saw the case.

An operation was recommended and performed December 14th, 1896, the anæsthetic being given by Dr. T. E. Stevens. A free incision exposed not, as was expected, a group of lymphatic glands, but a growth of malignant adenomatous character, sur-

rounded by traces of capsule, itself infiltrated with growth and adherent to the adjacent structures, especially the digastric and stylohyoid. It had certainly begun under the deep fascia, but in its course had involved this and reached the skin. It was only slightly adherent to the periosteum of the jaw. The submaxillary salivary gland had almost disappeared, being pushed aside, and in places infiltrated by the growth. A deep process of the growth passed upwards towards the stylohyoid process, and in the removal of this the posterior belly of the digastric and the stylohyoid were also taken away. Mr. G. Bellingham kindly examined the growth and reported that it was a squamous-celled epithelioma. Recurrence *in situ* took place very soon in the region of the scar, a mass rapidly appearing about the size of an apple, hard, irregular, and deeply fixed. The skin covering it soon became thin, and traversed by stellate venules. The growth was this time more fixed to the subjacent parts than before, and much pain was complained of from the tension of the swelling, and also in deglutition. On March 8th, 1897, a second operation was performed, but as, now, the growth had extended upwards into the pterygoid region and was of a still more infiltrating character, it seemed certain that this second interference would not be effectual. On this occasion the middle constrictor formed the floor of the wound that was left, and much trouble was required to avoid perforating the pharynx.

A consultation was held again on November 25th, 1897, when the following notes were furnished to me by Dr. de Mesquita. About eight weeks after the second operation the scars gave way at one spot, and on this occasion recurrence took place, not only in the left side of the neck, but extended from here across the larynx almost to the anterior border of the right sterno-mastoid. Further, two distinct nodules appeared, one in the left cheek and one opposite to the left angle of the jaw. The pain in the cheek was excessive, and the patient was unable to open her mouth more than to just separate the teeth owing to the tension and pain in the cheek, and consequently had to be fed with slops administered by a spoon. When the finger was introduced within the left cheek the mucous membrane was much ridged and

swollen, apparently pointing to involvement of the whole cheek, The swelling over the larynx became so tight and tense as to interfere considerably with breathing and swallowing. About the middle of July the swelling began to decrease, and gradually the whole of the recurrent masses entirely disappeared, with the exception of a firm, small nodule to the left of the thyroid cartilage. On this point Dr. de Mesquita remarked: "I am quite unable to explain this sudden and unexpected disappearance of what was undoubtedly a malignant recurrence, more especially as with this local change the patient's general condition greatly improved. I believe part of the tension was due to hæmorrhage into the growth, as, with the diminution in size, there appeared a yellowish staining of the skin all round the edges of the growth, as is usually seen after extravasation of blood. This, however, can only account for part of the swelling, the rest being certainly solid growth."

Certainly on November 25th, 1897, the change that had taken place was extraordinary. Save for two scars, one running from the lobule of the ear downwards and forwards across the sub-maxillary region of the chin, and a second from the centre of this obliquely outwards to the clavicle, and the suture-points, there was nothing to point to what the patient had gone through; of malignant disease there was not a trace. There was no difficulty in swallowing or breathing, and the patient could open her mouth to the normal extent, and was able now to take any position for rest at night. The anterior and posterior triangles were now depressed and small when compared with the opposite side. No glands were to be felt on either side or in the axillæ. There was no evidence of malignant disease in the chest or abdomen. The patient looked well. Three weeks before she had spent a fortnight in Holland, getting about and enjoying herself.

Two points in this interesting case are especially noteworthy. (a) The nature, origin and diagnosis of the growth. (b) The spontaneous disappearance locally of what was undoubtedly malignant disease. To aid those who may meet with similar cases it will be worth while to allude to the nature and diagnosis of the growths. It was clear from the way in which the growths

had infiltrated adjacent structures, and the absence of any lymphatic gland structure that the original diagnosis was wrong, and that the nature of the growth was malignant. When Mr. G. Bellingham Smith proved beyond all doubt that its structure was that of a squamous-celled epithelioma, I suggested that its origin could only be found in the remains of one of the branchial clefts as it clearly had no connection with the only squamous epithelia adjacent, viz., those of the skin or the pharynx. It is probably owing to their rarity, that while we recognise as not uncommon the origin of dermoid cysts of the neck in some inclusion of squamous epithelium from the foetal epiblast during the imperfect obliteration of a branchial cleft, epitheliomata of like origin have received very little attention, especially in this country. But in the diagnosis of a cervical swelling, if fixed and if situated anywhere near the sites of one of the branchial clefts, the possibility of its being a branchial cleft-epithelioma must always be remembered. The surgeon must not be misled by the absence of any connections with epithelial structures such as the skin and mucous membrane, by the locality which may exactly correspond to a group of enlarged glands, the possible presence of a source of irritation lying in the lymph-path of these glands (such as the carious teeth in Mrs. S.'s case). The early appearance of some of these epitheliomata is probably explained by the fact that the growth is originally congenital and dates to some aberration of developing epithelium. For if carcinoma is usually a disease of degenerating tissues, foetal undeveloped tissues may rightly be expected to undergo early degeneration. It is, however, to be pointed out later that these branchial cleft epitheliomata rarely appear early in life.

As to treatment, the chief lesson which these epitheliomata of congenital origin teaches is that for removal to be effectual exploration must be early; the patient must not defer it until four months have elapsed after rapid increase in the swelling has begun to take place, and extirpation must be conducted on very wide lines. Finally, no patient should ever be allowed to look upon a dermoid cyst as merely a disfigurement.

The following cases are all probably instances of the same rare but most important disease—branchiogenous epithelioma.

Mr. Silcock described three cases of cystic epithelioma of the neck at a meeting of the Pathological Society (*British Medical Journal*, vol. i., 1887, p. 620).

CASE 1.—A man, æt. 32, was admitted into St. Mary's Hospital with a large inflamed suppurating swelling under the lower third of the left sterno-mastoid muscle. He had first noticed a small lump in that situation about three months earlier; it was painful, and the patient, who was a strong healthy man, began to lose flesh and strength. The swelling had been opened, and after admission, Mr. Owen scraped away large portions of the growth, with temporary relief. After death, though no complete autopsy was allowed, it was ascertained that the growth occupied the posterior as well as the anterior triangle, and infiltrated all the structures. There was a large cystic cavity lined by prominent papillary granulations which were found to consist almost entirely of epithelial cells, the most highly developed being of the squamous type, but not prickled, forming well-marked nests and long columns running downwards into the mass of the tumour. The enlarged lymphatic glands lying over the growth were found to be due to inflammatory irritation only.

CASE 2.—A man, æt. 56, was admitted with a large, partly cystic tumour on the right side of the neck, which had been growing for about five months. He was emaciated. The cyst was incised by Mr. Pepper, and a quantity of glairy yellow fluid escaped. The cyst, which was lined with papillary granulations, subsequently suppurated. Examination after death revealed the same macroscopical and microscopical appearances as in the first case.

CASE 3.—A man, æt. 64, was admitted with a large tumour on the left side of the neck, lying in greater part beneath the sterno-mastoid muscle, but involving both triangles; it extended from the jaw to the clavicle, up to the middle line in front, and to the mastoid process posteriorly. Mr. Silcock tapped the swelling and drew off a thick yellow grumous fluid, which was found to contain numerous large epithelial cells, so that there could be little doubt that the condition was the same as in the two previous

cases. Mr. Silcock said that in none of the cases was there evidence of a primary growth elsewhere. He thought the only hypothesis which could be entertained was that they owed their origin to some belated portion of epiblast, perhaps the representative of a branchial cleft, although the advanced age of the individuals in whom they were found appeared to negative such a supposition.

The following fully reported and most interesting cases were brought by Mr. Treves, before the Pathological Society (Trans. vol. xxxviii., p. 360).

“ A cellarman, æt. 53, was admitted into the London Hospital on August 27th, 1885, with a tumour of the neck. He was a somewhat stout man, with fair muscular development. He was a trifle anæmic, and his face appeared a little puffy. He had had no sore throat nor any previous swelling in the neck. He had never had syphilis, was not the subject of rheumatism, and had been always a most temperate liver. The swelling in the neck was first noticed eight weeks ago, when he discovered by accident a hard mass about two inches below the left ear. The tumour grew steadily, and extended lower down in the neck; as it increased in size it became softer. On admission, there appeared on the left side of the neck, under the centre of the sterno-mastoid muscle, a swelling the size of a large goose's egg. It was very fixed; its general shape was roundish, but its outlines were a little indistinct. It did not move during deglutition, and was clear of the thyroid body. The skin covering the mass was red, and slightly cedematous. The tumour presented distinct fluctuation, but the periphery of the swelling was no denser than the central parts. The tumour was not tender, and the patient experienced no difficulty in moving the neck. Sharp pain had been felt along the supra-clavicular, great auricular, and small occipital nerves. The temperature was normal. An examination of the mouth, pharynx and larynx revealed nothing abnormal. The swelling was considered to be a chronic abscess. It was punctured with a trocar, but in the place of pus there escaped three ounces of clear mucoid fluid. This material was of pale yellow colour, and in consistence thick and gelatinous. It drew out into glairy threads between the fingers. It became solid on

boiling; thin and watery when mixed with liquor potassæ; it was coagulated by acetic acid. It presented, indeed, the chemical characters of mucus. Microscopically, nothing was discovered except a few blood corpuscles, many leucocytes, and some granular matter. The cyst appeared to be entirely emptied by the tapping. Some solid swelling remained, but it was no more in amount than would have been accounted for by the cyst wall. The cavity rapidly refilled, the skin became redder, and the parts around more swollen. The temperature rose, and on the fifth day after the tapping I opened the cyst freely under chloroform. The fluid that escaped was now muco-purulent. A large cyst was discovered, with thick and regular walls; the interior of the cavity was smooth; the tumour lay under the sterno-mastoid, and extended down to the thyroid body. A large drain was inserted, and the cavity was well washed out daily with a solution of iodine. The discharge now became entirely purulent and considerable in amount. The temperature kept high; the patient became anæmic and weaker. He was not, however, confined to bed until October 15th, about six weeks after the first tapping. At that time the discharge was very profuse, and the undermined skin about the wound, was beginning to break down. Throughout, the temperature had ranged between 99° and 102°. On October 9th, for the first time, bleeding occurred from the cyst. The cavity was plugged with perchloride of iron. The bleeding recurred next day, was very free, and led to pronounced anæmia and great prostration. The neck was now swollen, red and œdematous. The swelling was diffuse and could not be defined. There was slight dyspnœa. The patient was much wasted. The hæmorrhage did not recur, but the patient became weaker and weaker. Diarrhœa set in, and the man died of exhaustion on November 5th, about seventeen weeks after the swelling was first noticed.

Autopsy.—The cyst extended from the hyoid bone to the clavicle; it was placed beneath the sterno-mastoid and rested upon the left lobe of the thyroid and the thyro-hyoid muscle. It had no connection with the thyroid gland, the left lobe of which was flattened and greatly wasted. The cyst-wall appeared to have infiltrated the tissues; although it could in no place be separated

from the parts around, yet its limits were fairly defined. The wall was about half an inch in thickness, and, on section, white, fleshy, homogeneous, and evidently vascular. The interior of the cyst was very irregular, and the lining wall closely resembled that of the left ventricle of the heart, being thrown into numerous bar-like ridges. Near the opening into the cyst there was much granulation tissue, and from hence the pus had no doubt been derived. The rest of the cavity was quite free from granulations and perfectly smooth. The three carotid arteries were embedded in the cyst wall, but their lumina remained clear. The superior thyroid was lost in the growth, and it was from this vessel that the bleeding had occurred. The internal jugular vein was obliterated in the greater part of its extent. The superior laryngeal and sympathetic nerves were sound, but the vagus, just below the carotid bifurcation, was lost in the mass, and so well obliterated was it that no trace could be found on careful dissection. The patient only had dyspnoea when the swelling in the neck was excessive; was never sick, and had no symptoms that would suggest a lesion of the vagus. There were no enlarged glands in the neck, and no secondary deposit in any organs. On microscopic examination the tumour presented the features of a carcinoma. The cells were large and rounded, but altered in outline by mutual pressure. They were distinctly epithelioid in character. The alveoli were somewhat ill-marked, and the stroma scanty. The alveoli were so disposed that the cells were grouped for the most part in the form of elongated cylinders."

Mr. Treves discusses the possible modes of origin of this malignant growth. He mentions the "superior accessory thyroid gland," described elaborately by Streckeisen (Virchow's Archiv, January, 1886). This appears to be due to separation of a pyramidal process from one of the lateral lobes of the thyroid body, which is especially liable to take place in old persons. Secondly, a number of glandular bodies about the hyoid bone, which, according to Streckeisen, represent the remains of the central diverticulum which is protruded from the ventral wall of the pharynx, and from which the middle part of the thyroid gland is formed. Failing the above sources, Mr. Treves goes on to

remark: "There are still the epithelial masses and cords that have been discovered in the neck as the remains of imperfectly closed branchial clefts, and from such epithelium the present growth may have arisen."

Mr. Treves' closing words in his account of this case are of especial interest in their bearing on the mistaken diagnosis at first made in our case: "From a clinical point of view, the close resemblance of this cyst to a chronic abscess is worthy of especial notice."

The second case is identical with that just described, so far as its pathological characters are concerned. In it, however, the cystic element did not predominate. The patient was a woman, æt. 52, who was admitted into the London Hospital in November, 1885. She described herself as having been always strong and vigorous. She had had several children, all of whom were healthy. There were no evidences of syphilis. A very large tumour occupied nearly the whole of the right side of the neck; in front it reached to the middle line; behind, it had extended back nearly to the anterior border of the trapezius muscle. Its upper extremity was one and a half inches from the lower jaw, and below it was in contact with the clavicle. The skin covering it was thin, and of a dusky red colour. In two spots the integument had given way, and the growth was exposed and had commenced to fungate. Each of these districts was about the size of a shilling-piece. The skin was not adherent to the tumour, nor was it in any way infiltrated. The mass was fairly fixed, was placed beneath the sterno-mastoid muscle, and had pushed the trachea over to the left side. The posterior part of the growth was hard and resisting, but over that part of the tumour that extended between the centre of the sterno-mastoid and the middle line there was distinct deep fluctuation. The mass was displaced, laterally, on swallowing, and appeared to move a little in the vertical direction. No enlarged glands were discovered. The patient had first noticed the tumour six months before. It then appeared as a small hard mass about the size of a walnut, which was placed under the centre of the sterno-mastoid muscle. From this point the tumour grew in all directions, but especially down-

wards and backwards. For three months the woman remained in good health, and the growth caused little or no inconvenience. After that time, however, the tumour began to grow rapidly. It caused very intense pain; she became rapidly weaker and lost flesh. The skin over the swelling had only given way a few days before admission.

When first seen, the patient was weak and anæmic, and greatly wasted. The pain—produced apparently by pressure upon the cervical and brachial plexuses—was severe and constant. An examination of the viscera and of the rest of the body revealed nothing abnormal. There had been no hæmorrhage from the tumour. The temperature ranged from 99° to 100°. The diagnosis of sarcoma was made. As the patient clamoured for operation, and as the growth appeared to be well encapsuled, I attempted to remove it. The incision extended from the jaw to the clavicle. The external jugular vein was found obliterated. The wasted sterno-mastoid was cut through. The whole of the outer part of the tumour was well encapsuled, and was so readily exposed that it appeared at one time as if the whole mass would shell out with perfect ease. The deeper parts of the growth, however, had infiltrated the tissues. The great vessels were adherent to it. The carotids were bared; the internal jugular vein had to be divided, and its cut ends ligatured. The brachial plexus was exposed by the dissection; the growth was adherent to the larynx, trachea, and œsophagus, and in this direction it was obvious that complete removal was impossible. The amount finally left behind was inconsiderable. No enlarged glands were met with, and there was no trace of the right thyroid lobe. Little blood was lost during the operation, and none subsequently. The patient remained profoundly exhausted after the operation, and from this exhaustion she never rallied. She became very restless, and died three days after the tumour had been removed. An autopsy was not allowed. The greater part of the growth was provided with a thin but distinct capsule. It was only at what may be called the pedicle that infiltration had taken place. It was evidently at this point, which would be represented by the tissues immediately under the centre of the sterno-mastoid, that

the tumour had its origin. The posterior part was solid; the anterior cystic. The solid portion represented more than two-thirds of the entire tumour. This segment was firm, and on section precisely resembled the cyst wall in the previous case. It was pale, homogeneous, and fleshy. The cystic part was composed of a single large cyst with many loculi. The lining membrane was smooth. The cyst wall varied in thickness from two or three lines to nearly half an inch. The fluid evacuated was of a pale yellow colour, quite clear, and in consistence thick and glutinous. It amounted to two and a half ounces, and was identical with the material discharged in the previous case. A microscopic examination of the solid parts, and of the cyst wall, revealed the same structure as that already described—large epithelioid cells lodged in alveoli. The stroma was so arranged that the cells appeared grouped in elongated cylinders, and so narrow were these cylinders that in the majority there were only two cells abreast. There was no reason to suspect the existence of secondary deposits in any part. This case would not rightly be included among malignant cysts. The solid part of the growth predominated; it is recorded, however, because it serves to illustrate and supplement the case first described. In structure, and in the nature of the cystic contents the two were perfectly identical. They sprang from the same region, although not from the corresponding side of the neck. In both instances one lobe of the thyroid body had been practically destroyed. In the one case it had wasted from pressure; in the other it had been invaded by the growth. In both instances mucoid degeneration had occurred. In both, also, the general clinical character of the growths was that of sarcoma, while from microscopic examination it appeared that they should be classified as carcinomata. It is well to note also that the cyst was provided with a distinct smooth lining wall, and that the mucoid matter it contained was unmixed with débris.

The third patient was a painter, aged 43, who was admitted into the London Hospital in May, 1884, with epithelioma of the tongue. The man was in fair health, and there was no evidence that he had ever been the subject of syphilis. The ulcer was

quite small, and was limited to the right border of the tongue. The anterior extremity was three quarters of an inch from the tip of the organ. The rest of the tongue was healthy. The ulcer had existed for four months. A small indurated gland was to be felt under the right lower jaw. Nothing could be detected in the left side of the neck. As a precaution the patient was treated for three weeks with iodide of potassium in increasing doses. The ulcer was not affected thereby. The patient had never suffered from lead-poisoning.

“In June I ligatured the right lingual artery in the neck, and removed the whole of the right half of the tongue with scissors. In exposing the artery the enlarged gland was encountered and removed. No other gland was detected. The ulcer was found to be quite limited to the margin of the tongue. The wounds healed well, and the patient left the hospital in fourteen days to resume his work. He returned again in August, 1885, some fourteen months after the operation. In the interval he had felt well, and had been regularly engaged in work. The tongue was quite sound. The wound on the right side of the neck was well healed, and no glandular enlargement could be detected beneath it. There was now in the *left* side of the neck a swelling the size of a duck's egg. It was placed beneath the sternomastoid, extending nearly to the mastoid process and to within one inch of the median line. The muscle was stretched over it and made to deviate a little. The mass was firmly fixed, was tense, and presented a sense of fluctuation. The limits were ill defined. The skin over it was neither red, œdematous nor adherent. No enlarged glands could be felt about the tumour. The mass was a little tender, but painless. The movements of mastication and of swallowing were performed without difficulty. The neck was kept stiff, and much pain was felt along the superficial cervical, great auricular, and small occipital nerves. The temperature was normal. The patient's teeth were much decayed, but nothing abnormal could be detected in the mouth, tongue, nose, nor in any part of the periphery, with which the cervical glands are concerned. The man was not anæmic, nor had he lost flesh. The swelling was discovered by accident two months ago. It was at

first hard. As it enlarged it became softer. At the end of a week the swelling had increased in size, fluctuation was very distinct, and I imagined the case to be one of abscess. On introducing a trocar into the cyst, three ounces of clear yellow serous fluid escaped. A drachm of iodine was injected, and the cannula removed. The fluid presented the physical and chemical characters of lymph. Under the microscope a few leucocytes were observed. After standing for a while a very slight flocculent deposit formed. This was found to be composed mainly of epithelial cells, some free, others collected together in masses. In a few days the cyst had regained its original size and produced much distress, thereupon I laid it freely open under an anæsthetic. Several ounces of a lymph-like fluid mixed with iodine escaped. On examination the cyst was found to lie in the connective tissue under the sternomastoid. Its lining membrane was quite smooth and even except at one spot on the deeper wall. Here, over an area of about one square inch, a hard projecting cauliflower-like mass could be felt. No bleeding followed the examination. The patient seemed for a while much improved, and from the tube introduced into the cyst a little flaky pus escaped. There was no oozing of serous fluid. Fourteen days after the incision the patient had a slight rigor, and the temperature—that had up to this time been normal—rose to 102°. He rapidly lost flesh and strength; his appetite entirely failed, and he was troubled with profuse sweatings. He had no repetition of the rigor. His urine was healthy, and nothing abnormal could be detected in any of his viscera. The incision still discharged a little pus, but the site of the cyst was now replaced by an indistinct solid mass. The patient developed a slight cough, and had some trouble in swallowing and breathing. Within eight days after the rigor the man was greatly prostrated. His temperature remained between 99° and 100°. Venous bleeding now occurred from the wound; the cyst filled with blood, and extreme dyspnœa resulted. All attempts to arrest the bleeding failed, and after it had continued for twelve hours the patient died.

Autopsy.—The body was much emaciated. In the apex of the right lung two small cretaceous nodules were found. With this

exception all the viscera, apart from being anæmic, presented a normal appearance. No secondary deposits of any kind could be found. The cyst was filled with blood-clot, and the larynx pushed over to the right side. On removing the clots the larynx returned to its normal position. The cyst was oval in shape, and extended from the mastoid process to within a short distance of the clavicle. It reached in front nearly to the middle line, and behind to the posterior border of the sternomastoid muscle. It was quite free of the thyroid body. Near the lower end of the cyst one small indurated gland was found. It was softened in its centre and appeared to be breaking down. This was the only enlarged gland detected in the body, and it might here be said that its structure was identical with that of the cyst wall. The interior of the cyst was irregular, and its surface was thrown into distinct but smooth ridges, very like the columnæ carneæ of the ventricle. In this respect the three cysts were singularly alike. The three carotid arteries could also be felt through the parietes as three wide cords. Over about one-third of the lining wall was a cauliflower growth that was evidently epitheliomatous. The cyst wall varied in thickness from one-eighth to one-sixth of an inch. On section it was dense, fibrous, yellowish and homogeneous. It was most intimately blended with the structures in its vicinity, although it had invaded the muscles to a less degree than the connective tissue and blood vessels. It had spread a little into the parotid gland. The walls of the carotid vessels were invaded, but the lumina of those trunks were free. The superior thyroid, lingual, facial, and occipital were buried in the cyst wall and were entirely occluded. The vagus nerve was also embedded in the new growth. The hæmorrhage had occurred from the internal jugular vein. This vessel was thrombosed above the bleeding point but free below it. The larynx and gullet were free from disease, and no enlarged glands could be found in the mediastina. There was no appearance of any return of the cancer in the right side of the tongue nor in the right side of the neck. A careful examination revealed nothing abnormal. In the excision the median line had not been transgressed. A microscopic examination shewed that the tissue of the cyst wall was the tissue of an epithelioma.

Between the cylinders and masses of epithelioma there was a fair amount of small-cell growth. There were the usual epithelial nests. The precise character of this malignant cyst must be open to a certain amount of doubt. It would be fair to assume that it was a secondary growth, following upon the epithelioma of the tongue, and that it had taken its origin in a lymphatic gland. It is remarkable that such a deposit should have occurred on the left side of the neck, while the primary epithelioma was entirely limited to the right side of the tongue. The phenomena, however, could be explained by supposing some unusual anastomoses of the lymphatics. A like cross-infection has been met with in the groins, in association with syphilitic sores upon one side of the penis. The formation of the cyst I imagine to be due to some peculiar obstruction to the lymph current. Of the manner in which the lymph circulation is affected in the early stages of secondary gland enlargement we know nothing. The possibility that lymph may have still been poured into the gland after it had become the seat of an epitheliomatous deposit cannot be denied. There is no reason to suppose that the fluid had escaped from the growth, and no evidence to show that it was derived from the breaking down of the same. The rapid progress of the tumour is worthy of note. But for the strong probability that the mass was of secondary formation it would be interesting to speculate upon its connection with some of the epithelial collections often met with in the neck as the result of incomplete development, and especially with the occasional duct that Streckeisen describes as running from the foramen cæcum to the vicinity of the hyoid bone. If this last case and that first described are compared the resemblance between the two is very striking. The patients were adult men; the tumour was upon the left side of the neck; the rate of growth was about the same; the time that elapsed between the discovery of the mass and the death of the patient was thirteen months in one instance, and seventeen in the other; in both cases the local manifestations were those of abscess, and in both the patients died of hæmorrhage; the tumours were quite local; there were no secondary deposits; and the growths had both sprung from corresponding regions in the neck. While the clinical likeness

was singularly complete, the histological differences were as singularly marked. One was an epithelioma, the other a spheroidal-celled cancer. One was apparently a secondary growth, the other was primary. In one the contents were lymph-like, in the other mucoid."

While at once allowing that it is presumptuous to criticize and to differ from the diagnosis of another surgeon in a case which I never saw, I should have thought that there were a few points in the third case, one especially, which were strongly against the view that the cystic epithelioma originated in a lymphatic gland, secondary to the disease in the tongue, and which favoured its arising independently, possibly in some branchial relic, though if this were the case, the coincidence was a striking and most unusual one. The point I especially allude to is the fact that a carefully conducted autopsy proved that only one enlarged gland existed. Thus the report runs "Near the lower end of the cyst one small indurated gland was found. It was softened in its centre, and appeared to be breaking down. This was the only enlarged gland detected in the body." A very large experience of tongue cancer enables me to say that a recurrence in the glands of the neck after tongue cancer—a recurrence limited to two glands, one converted into a large cyst, is so absolutely contrary to the usual course as to entitle one to look upon such a case with much suspicion, if not to go further, and to reject it altogether. Secondary epithelioma in the cervical lymphatic glands, as is well known, usually spreads from group to group with concomitant evidence of septic as well as malignant invasion, from the fact that from the primary focus, usually an ulcer, septic products as well as those of a malignant growth, have made their way into the lymphatics.

The following carefully reported case carries with it additional interest and weight from the name of the surgeon, Mr. Bowlby, who brought it before the Pathological Society (Trs., vol. xlvii., p. 166).

"D. I., æt. 58, was admitted, under my care, into St. Bartholomew's Hospital, on September 3rd, 1894, suffering from a swelling in the right side of the neck. He stated that the

swelling first made its appearance only five or six weeks previously, and that it began as a small hard lump. This rapidly increased, and three weeks later was treated with Ung. Plumb. Iodid., under the impression that it was of an inflammatory nature. He suffered a good deal of pain for a fortnight before admission, and had lost flesh. The past history and the family history were unimportant. The patient looked ill and was thin. At the right side of the neck was a large swelling, covered by dark purple skin, which was tightly stretched and thinned. The swelling was oval, and lay with its long axis from above downwards. It measured eight inches by four inches, and occupied almost all the right side of the neck. Further examination showed that the greater part of the tumour was fluid, fluctuation being very distinct, but the deeper part of the mass was hard and fixed, and the glands around appeared to be hard and enlarged. The glands in the left side of the neck also appeared to be larger and harder than normal. Careful examination failed to detect any disease in the mouth, fauces, larynx, or œsophagus, and there were no symptoms pointing to any affection of these parts. The viscera appeared natural. Before the admission of the patient, the swelling had been considered to be a large abscess, but the fixity of its base, and its hardness, seemed to point to malignant disease of an epitheliomatous nature. In the absence of any primary growth on the skin or mucous membrane in the neighbourhood, it was further considered that the case was one of primary epitheliomatous cyst of the neck, for it resembled in almost every particular the tumours of this nature shown at previous meetings of this Society in the year 1887 (vol. xxxviii., pp. 360 and 374), by Messrs. Treves and Silcock. It was unfortunately only too evident that no operation for the removal of the tumour could be entertained, and as the skin was already involved and the cyst was threatening to burst, the patient was put under the influence of an anæsthetic, and the cyst was incised. It contained about half-a-pint of serous, blood-stained fluid, and when this had been evacuated, the wall was found to be studded with tuberos masses of new growth, one of which was removed for further examination. The cyst was drained, and

gave rise to no further trouble, but the patient was very feeble, became wandering and delirious after a week or two, and, without any evidence of further disease, slowly sank and died three weeks later. For the following notes of the post-mortem examination I am indebted to Mr. James Berry: *External Appearances*.—Rather thin, in left mammary region two deeply pigmented moles, the larger about a quarter of an inch in diameter. On right side of neck, one and a half inches above middle of clavicle, an opening large enough to admit a forefinger, leading directly into a large cavity; the edges were slightly thickened. No trace of branchial cleft, dimple or supernumerary auricle or any other congenital malformation. *Head*.—Brain and membranes normal. *Neck*.—The right side of the neck was somewhat swollen, the swelling being due to a large malignant cyst occupying both the anterior and posterior triangles of the neck. It measured three inches vertically, extending from the level of the hyoid bone down to the clavicle. It measured nearly as much transversely, extending from the side of the larynx and thyroid gland far back into the posterior triangle. It lay beneath the sterno-mastoid, but superficial (or external) to the sterno-hyoid and sterno-thyroid muscles. Posteriorly it just touched the edge of the trapezius. The omohyoid lay behind it, and projected as a prominent ridge into the cavity of the cyst. The prevertebral and sterno-mastoid muscles and the nerves of the cervical and brachial plexuses were more or less adherent to and infiltrated by the growth. About three inches of the internal jugular vein appeared to have been completely destroyed by the growth. The carotid artery, vertebræ, clavicle, larynx, trachea, thyroid gland, pharynx and œsophagus were all unaffected, being neither infiltrated by nor adherent to the growth. The cyst was collapsed, containing only a small quantity of dirty pus and broken-down epitheliomatous material. There was also some dirty pus in the cellular tissue below and inside the tumour. The wall was about a quarter of an inch thick, and presented internally a somewhat rough tuberculated appearance; the exterior of the cyst was firmly adherent to neighbouring structures. It was composed of tolerably firm white new growth. Outside the cyst and close to it were a few small nodules of

growth, apparently glands, chiefly at the inner and lower part. The lymphatic glands of the left side of the neck and those of the thorax were quite free from disease. The growth did not present the appearance of a mass of epitheliomatous glands breaking down in the centre, but rather that of a cyst, the wall of which had been converted into an epithelioma. The epitheliomatous wall was of about the same thickness everywhere. The mucous membrane of the nasal passages, mouth, pharynx, œsophagus, stomach, intestines, down to the anus, larynx, including the ventricles, trachea and bronchi were all examined carefully, and showed no sign of any primary disease. The lungs were both much engorged and œdematous; the right apex was firmly fixed by old adhesions. There were no signs of secondary affections of any other part of the thoracic or abdominal viscera. The left kidney contained a cyst as large as a hazel nut; otherwise the abdominal viscera were all quite healthy. Microscopical examination of the cyst wall showed that the growth was a typical squamous-celled carcinoma. The above case is in almost all respects similar to those already alluded to as described in a previous volume of the "Transactions" of the Society. The presence of squamous epithelium in a tumour in such a position as that occupied in question is, I believe, only to be explained satisfactorily by a growth from similar epithelium of foetal origin in the branchial clefts—an explanation which has already been offered by Messrs. Treves and Silcock. It is quite certain that the growth was not secondary to any primary tumour in the face or neck, and it could not have sprung from the thyroid gland. I think, further, that the large collection of fluid which characterises tumours of this class, and which is immensely in excess of that which may complicate the development of other epitheliomatous growths, suggests that there is probably a potential cavity in the wall of which the tumour commences, and which is distended by the secretion from the affected lining membrane. It is to be noted that the cysts in all these tumours had a tolerably definite wall studded over with tuberos masses of epithelioma, and that none of them looked at all like cysts due to degeneration in the centre of a growth, for such cysts are invariably very ill-defined,

their contents resemble thin sebaceous matter, and their surface is always ragged and shreddy. There appear, therefore, to be very good reasons for believing that these "epitheliomatous cysts of the neck originate in the branchial epithelium."

Dr. L. A. Power, Professor of Surgery in the University of Denver, Colorado, reports (*Annals of Surgery*, February, 1898) a case which came under his notice in the practice of Dr. W. T. Bull, of New York. "In the autumn of 1891, a lady, æt. 48, presented herself with a hard, rather diffuse swelling at the right side of the neck. The mass had been growing slowly for something over a year; was about the size of a pigeon's egg, irregular, deeply seated beneath the angle of the jaw, and stretching backwards to and from beneath the sterno-mastoid muscle. The tumour was partially fixed, was not painful but slightly tender. The skin over it was not involved. Careful examination of the ear, nose, mouth, pharynx and œsophagus revealed nothing abnormal. *Operation.*—By an incision of appropriate length the tumour was reached. It was found to be without a capsule and to be adherent to the surrounding structures. It was dissected out, and with it was removed a liberal area from the adjacent tissues. None of the important vessels or nerves were wounded. Closure of wound; prompt healing. The tumour was solid; its cut surface was greyish and firm; it presented the gross appearance of a malignant growth. It was sent to Dr. F. Ferguson, pathologist to the New York Hospital, who pronounced it carcinoma. A year later an enlarged gland, the size of a hazel-nut, was removed from the region of the scar. It was also pronounced epithelioma by the pathologist. The patient has been seen at frequent intervals since, but no further enlargement has been discovered. At this time, six years after the primary operation and five years after the removal of the recurrent lump, she is apparently free from relapse, and may be reported as probably cured. The original growth may be looked upon as a bronchio-genous carcinoma."

Very brief and meagre abstracts of twenty cases are given by Dr. Power in his paper.

The following rendering of Prof. R. v. Volkmann's paper (*Das tiefe branchiogene Hals carcinom*, Centr. f. Chir. Bd. ix. SS. 49-51) in which attention was first drawn to this important variety of epithelioma may be of interest to some. It has attracted too little attention in this country. Since I became acquainted with it I seem to recall several cases of growth in the neck, clearly malignant, in which I hunted in vain for any primary lesion on the surface, or in the pharynx, and in which the diagnosis was never cleared up.

"I have three times, during the last ten years, found carcinomata deep between the muscles in the upper cervical triangle, which were connected neither with the outer skin, nor with the mucous membrane of the pharynx; they certainly did not originate in diseased lymphatic glands, and from the absence of carcinomatous formation in any other part must be considered as primary. The patients were men between forty and fifty years. In one case the tumour was on the right, and in two on the left side. Their size varied between that of a large plum and a child's fist. The consistence was at the beginning always very firm and scirrhus; still, in one of the cases, there quickly came on, later, that condition of mucoid softening which is so frequent in secondary disease of the lymph glands at the angle of the jaw and the parotid region after cancer of the lip and face, so that there was a great fluctuating sac, which had pushed the larynx and great vessels wide apart from each other, reached upwards to the base of the skull, and caused very violent dyspnœa and dysphagia. But even in this stage the skin was still intact, raised in folds, with the new growth, and when the finger was introduced into the pharynx, it could be demonstrated with certainty that, as in both the other cases, the mucous membrane over the tumour was intact and movable. Total extirpation was in this case, that had already advanced too far, no longer possible, although an exploration was made. I was obliged, therefore, to limit myself to incising the softened tumour, evacuating its contents, and extirpating its anterior wall. The course was favourable to begin with; the tumour shrank; the dyspnœa, and likewise the dysphagia

decreased; but the patient soon after went home and died of severe hæmorrhage caused by erosion of the carotid.

In the two other cases tumours were extirpated lying between the larynx and hyoid bone on the one side and the great vessels on the other, reaching backwards close to the pharyngeal mucous membrane and upwards directly to the styloid process. The operation was in both cases a difficult and extensive one, as the new growth was not merely diffused in the muscles of the neck, but had everywhere throughout its limits given rise to a sclerotic connective tissue induration, characteristic of so many epitheliomata. Especially was the tumour so firmly adherent to the great vessels that in both cases a portion of the internal jugular vein was excised, and in one the common carotid had to be ligatured. In both cases, moreover, large portions of the muscles of the neck had to be sacrificed, especially of the already invaded sterno-cleido-mastoid lying in close juxtaposition to the new growth. On the contrary, the tumour was not connected with the submaxillary gland, which proved to be perfectly intact in both cases, and could easily be detached even in its deep part from the pharynx, so that the latter was not injured or exposed. The cut surface of the fresh tumour had somewhat the appearance of a hard ganglion of mammary cancer, and a fine vesiculated marking could be recognised, so that the alveolar structure of the tumour and the fat metamorphosis of the cells in the alveoli could be discerned with certainty even by the naked eye.

Microscopic examination showed there to be in all three cases undoubted carcinoma, in general belonging to epithelioma, with the formation of numerous stratified globules and emboli, and large laminated cells of the well-known form of epithelioma, even though at separate places the shape and disposition of the cells more called to mind cylindro-epithelioma. The stroma was very dense, consisting of thick bands of sclerotic connective tissue. In the neighbourhood of the new growth there was an exceedingly abundant small-celled infiltration and dense induration.

In the one case examined very carefully by Professor Ackermann, that of a patient aged 49 (a colleague), who unfortunately died ten days after the operation, likewise of hæmorrhage from a

muscular branch of the common carotid ligatured close to its exit from the artery, the large laminated cells appeared in the well-known manner to be beset with prickles and ridges. Still here, however, the far-advanced retrogressive metamorphosis rendered examination difficult. Of the carcinomatous nature of the tumour—finely alveolar and thickly furnished with epidermis—there could be no doubt. The large epithelial cells were so close together that they had to be isolated for examination with caustic soda. If we consider the position of these tumours, their development deep between the great vessels, the hyoid bone and the larynx, their histological structure necessarily requiring development from some kind of epithelial layer, it is no remote conjecture that they are closely related to the deep cervical encysted tumours, and are developed from epithelial cell germs, which, in the process of involution of the branchial clefts, remain lying in the deep tissues, until a powerful but to us quite unknown stimulation excites them, after long quiescence, to heteroplastic proliferation. I have, therefore, no hesitation in designating this carcinoma as branchiogenic or branchial, and of adding this form to the branchiogenic cervical cysts (Roser, Schede), as well as the branchiogenic chondromata and chondrosarcomata of the submaxillary and parotid, cheek and ear regions. It is manifestly the rarest. For in general we must, as surgeons, in opposition to Cohnheim, hold firmly to the opinion that the tumours, really developed from embryonal germs, have a benign character, and that infectivity is wanting in them. Plainly, abnormal implantations of epithelial germs are extraordinarily numerous. The dermoid on the orbital margin is one of the more frequent and most typical forms. Still, in no one case have I seen a subcutaneous carcinoma develop even in this place.

The three observations given of tumour-formation in the deep parts of the neck, in the typical position, however, of the embryonal branchial clefts, are the only cases in which, up to now, I have felt justified, even in cancer, of basing the hypothesis on the germinal layer. The enigma of carcinoma is not solved by this hypothesis—only its occurrence in an unusual position explained."

The following conclusions, drawn from the cases given above, may prove helpful in the diagnosis of Branchiogenic Carcinomata :—

i. In examining the nature of a suspicious growth in the neck, it must always be remembered that just as in early life dermoid cysts may originate in some epithelial remnant of the epiblast persisting between the different branchial arches, so, later on, such epithelial remnants after lying dormant and latent for years, may, under the influence of some entirely unknown stimulus, take on a rapidly malignant character.

ii. Branchiogenic carcinomata appear to be more common in men than in women.

iii. The great majority of patients are approaching or have passed middle life. In only ten is the duration of the growth given as being over a few months, or at most a year. Any congenital history is wanting. In only one case (published by Richard, from the Clinic of Professor Bruns, of Tübingen) is it stated that the patient, æt. 43, had had a cyst of the neck from childhood. The case of next longest duration, in fact the only other one of any duration, is our own, in which, in a patient of thirty-six, a swelling of some kind had been noticed in the same place for twenty years.

iv. They are usually first noticed in one anterior triangle near the anterior border of the sterno-mastoid, and more commonly in relation to its upper part. If of longer duration the growth may occupy both anterior and posterior triangles.

v. They may simulate, in their earlier stage, inflammatory swellings. This resemblance may be rendered closer and made deceptive by the coexistence, as in our case, of one of the ordinary causes of inflamed glands, and by the site of the growth exactly corresponding to that of a clump of lymphatic glands.

vi. Fixity to the adjacent parts and a lack of definition of the outlines of the growth are (while also common to inflammatory swellings) early and important features.

vii. It is not uncommon for the growth to be cystic in large part. This, again, like their simulation of inflammatory swellings, may be misleading. If the swelling be tapped, the fluid may be

serous, yellow or blood stained ; in other cases glairy and mucous, and in yet others thick and grumous. The presence of cells of the type of squamous epithelium should always be sought for in the fluid. If, after tapping, sepsis should occur, a fatal result is much hastened, rapidly increasing asthenia setting in, and sometimes hæmorrhage.

viii. When once malignant degeneration sets in, growth is rapid, and equally rapid is the infiltration of adjacent parts.

ix. Any operation to be successful, must be undertaken at an early stage, and carried out on wide lines. As in other epitheliomata, the contiguous glands are liable to become involved.

Since this paper was written our patient has died. Dr. de Mesquita writes as follows :—

“For three months before death, which occurred on March 8th, 1898, the patient suffered from extreme weakness, a high temperature averaging 101° (morning) 103·5° (evening). Very troublesome painful cough, and some œdema of legs.

It was not easy to explain why the temperature kept up, as there was an entire absence of physical signs of any morbid condition about the body. Towards the end, the patient experienced great pains in the legs similar to the “lightning pains” of *Tabes Dorsalis* and suggestive of nerve-pressure in the region of the spine, but at no time could any growth be discovered either in the abdomen, chest, or in the original site of the disease. The heart became weaker and weaker, and death was ultimately due to exhaustion. Dr. Frederick Taylor saw the case twice with me during the last illness.”

MYELITIS AND OPTIC NEURITIS.

By FREDERICK TAYLOR, M.D.

THE association of Optic Neuritis with Myelitis has not infrequently been recorded, but while the explanation of this connection is still doubtful, the account of an additional case may prove of interest.

Martha Matilda P., æt. 33, was admitted into Guy's Hospital on September 26th, 1893. She was at first under the care of Dr. Washbourn, but was subsequently transferred to Dr. Taylor.

Family history has no bearing on the complaint.

She has worked at a pickle-yard, in wet and damp, for years. She is married and has seven children. The last child was born nine months ago. She is believed to have been pregnant twice since then. She is also said to have drunk a great deal.

On September 4th she was at work. She first complained of pain in the head and eyes. She continued to work till the night of the 5th, but during that day she lost the sight of the left eye, and that of the right eye was dim. On September 6th she could not see at all. She saw a medical man, but there was no improvement in her sight, and on September 20th the left leg became "stiff, with no use in it," and simultaneously she could see a little—"enough to tell what dresses her friends had on." On September 21st the right leg became stiff, with no power; and on the next day the legs were quite powerless, with no feeling in them. After this her eyesight was again lost, and she had some retching, but no vomiting.

On admission.—She has a florid complexion, and does not look ill. She cannot see anything; everything is total blackness; the pupils are dilated, but react to light; the fundus appears to be normal; no ocular paralysis. The legs are quite flaccid and powerless, that is, she says she cannot move them, though when the house-physician went round at night, she was found to be lying on her side with the legs slightly flexed. There is complete loss of sensation to pain and touch above to the level of the breasts in front, and the scapular angles behind. There is no knee-jerk, no plantar reflex, and no ankle clonus on either side. The bladder is distended up to the umbilicus, and fifty-six ounces of urine were drawn off by the catheter. The urine is dark and turbid, sp. gr. 1016, slightly alkaline, contains a little albumen (less than one per thousand), and a little blood; no sugar. The deposit showed under the microscope blood corpuscles and crystals of ammonio-magnesian phosphate. The lungs appear to be slightly emphysematous; the heart is normal. Pulse 110, respiration 16, temperature 98·2°.

On the 28th a little light was visible to her. She was unable to smell, but could distinguish salt and sugar after a little thought, Hearing is perfect. She said she could not swallow because of a lump in the throat. A strong faradic current only caused a little movement of the muscles of the leg: in the anterior muscles KCC. > ACC. On the evening of this day the temperature rose to 101·5°.

On September 29th urine was passed unconsciously into the bed two or three times in the day; and on the 30th the anæsthesia had spread slightly upwards.

During the next week there was no material change. The temperature oscillated between 97° and 101°. The urine was retained, and sometimes overflowed; it was slightly alkaline, and contained pus corpuscles. I examined the fundus and found the discs pale, but normal. Faradism applied to the external popliteal nerve on each side caused moderate contraction of the muscles supplied by it. There was contraction of the right extensor brevis digitorum on direct application, but none of the left. Direct application to the calf muscles caused slight con-

traction. The thighs were not fully tested. She complained of pain in both legs and the lower part of the body, and later in the back of the neck. During this week she menstruated. On October 7th there was no reaction of either pupils to light.

During the second week of October there was apparent improvement in vision. She could distinguish light from dark, tell whether fingers were separated or held close together, and distinguish shapes. The left arm was now found to be weaker than the right, and both indeed very weak, for the dynamometer showed only thirty pounds grasp with the right and ten pounds with the left; the next day thirty pounds and fifteen respectively. The loss was greatest in the forearm, less in the upper arm. The sensation varied; mostly there was only a sensation of tingling in the forearm and hand on touching the skin, and anæsthesia only of the little finger. Paralysis and anæsthesia persisted in the lower extremities and lower abdomen, and the breathing was abnormally diaphragmatic.

October 15th to 21st. No great change. On the 16th Mr. Brailey examined the eyes and reported:—

“There was no convergence of the eyes for near objects; there was no reaction of the pupil to light; and there was no fixity of the eyes procurable. On ophthalmoscopic examination the outer edge of the discs was whiter than normal, and the arteries were narrower than normal. The whole condition of the eyes was compatible with the obsolete diagnosis of *Ischæmia Retinæ*.”

The weakness of the left arm continued and rigidity developed in it. Bedsores began to form over the sacrum, and the external malleolus.

On October 27th, no faradic contraction could be obtained in the muscles of the legs. Galvanism gave slight reaction—KCC. > ACC. On the same day a band of hyperæsthesia and tenderness was observed at the lower part of the chest. The anæsthesia extended as high as the junction of the sixth rib with the sternum, and above this up to the fourth rib is the band of hyperæsthesia, extending horizontally round to the spine, where it rises somewhat. Between the hyperæsthesia and anæsthesia is a “ring of pain.” This band of hyperæsthesia quickly increased

in extent downwards, thus encroaching on the anæsthesia. On November 2nd it reached below the epigastric angle, and on November 9th it was nearly as low as the umbilicus, reaching backwards so as to correspond with the space between the sixth dorsal and third lumbar spines. The abdominal muscles were paralysed.

On December 2nd there were shooting pains down the legs, and a sensation as if the legs were jumping or starting; but no movements were seen, and no voluntary movements could be performed. The pains continued for some days. During the night of December 3rd she had great pain in the left arm, and the next morning could move it much more freely, raising it easily above her head.

December 18th, electrical reactions as follows:—None to faradism in any of the muscles of the lower extremity. To galvanism: right rectus femoris ACC. > KCC; in other muscles ACC. nearly = KCC. On December 18th, there is a return of sensation in the legs below the knee, but a touch on the right leg is referred to the left, and the sensibility is excessive (hyperæsthesia). On December 22nd, sensation was still present in the legs, and there was some power of voluntary movement in the thighs; and a week later there was both sensation and slight motion in the toes.

On January 5th, 1894, the upper limit of the anæsthesia was the upper border of the sixth rib on each side in the nipple line, but between the nipple and the sternum on the right side it extended up to the lower border of the fourth costal cartilage. No band of hyperæsthesia was recognised when tested with a hot sponge. Slight sensation in feet; allochiria elsewhere. No knee-jerks, abdominal reflexes, or ankle clonus.

Dr. Hale White now found the optic discs in a condition of atrophy; her vision varied a good deal. In the beginning of April she could see objects at a distance of fifteen or twenty yards, but could not distinguish colours; but even at a shorter distance she was often wrong in recognising objects, and could not distinguish letters. The discs were bluish-white. The lower extremities were still quite paralysed; they were thin, the muscles

were flaccid and appear wasted. Sensation was impaired, and she had allochiria in the right leg, not in the left. The band of hyperæsthesia was not recognisable. The reflexes were absent. The pains in the legs, the incontinence of urine and fæces, and the bed sore persisted. The left arm was not apparently paralysed, but the dynamometer gave as before:—right, 40; left, 15. On April 25th, allochiria was noted in the left leg also.

A month later, May 28th, the band of hyperæsthesia was again observed, about two inches broad, in a wavy course across the chest, chiefly between the fourth and the sixth ribs; it rose highest on the sternum, and on the left side dropped to the sixth space and seventh rib. On the right side it extended transversely backwards to the spine, but not on the left side. The conditions remained very much the same on September 10th, when she was removed to a workhouse infirmary. She had still complete paralysis of the abdominal muscles and lower extremities; anæsthesia of both limbs with the following exceptions:—Sensation in right toes; allochiria in right leg and thigh when firm pressure was applied; slight sensation to firm pressure on the under surface of left toes; an irregular band of hyperæsthesia at the lower part of the chest above the anæsthesia. No knee-jerks, no ankle clonus, no abdominal reflexes; slight plantar reflexes were present, as well as wrist-jerks, and elbow-jerks. Incontinence of fæces and urine; bedsores on sacrum and each trochanter. Atrophied optic discs and much impaired vision.

The temperature showed irregular but moderate oscillations during the first six weeks of her stay in the hospital, chiefly between 98° and 101°, but sometimes reaching 102° and 103°. During November it was more continuously high, between 100° and 102°, only once touching normal. After this it ranged at a lower level, again between 98° and 101°, without much oscillation, until the middle of January. From this time it varied little from the normal.

This patient died in the infirmary on October 24th, 1894, six weeks after her removal from the hospital, and nearly fourteen months from her first symptom. No notes of her condition in

the infirmity appear to have been preserved, and I have been unable to ascertain whether a post-mortem inspection was made.

The above case agrees in many particulars with the majority of the cases hitherto published. At the end of this article is a list of published cases and articles, gathered for the most part from two of the articles there named by Devic and by Katz.

The points we may consider are :—

The nature of the spinal affection.

The nature of the visual disorder.

The relation to one another of those two conditions.

The spinal lesion.—Recovery from this combination has rather frequently been observed, so that an absolutely positive statement as to the lesion in all cases cannot be made ; but the lesion has been either demonstrated or inferred to be in the majority of cases a disseminated myelitis, acute or subacute, situate in the dorso-lumbar region. In this case also, not because of recovery, but from the unfortunate omission to make a post-mortem inspection, the condition of the spinal cord is a matter of inference indeed, but one of very little doubt. The rapid development of anæsthesia, complete paralysis of the lower extremities, loss of all reflexes, implication of the bladder and rectum, and, later on, marked flaccidity of muscles, point to an extensive destructive lesion of the spinal cord, the upper limit of which was high enough for the arms to be slightly involved, both in motion and sensation, while on the trunk sensation was profoundly affected as high as the fourth rib in front, and the abdominal and spinal muscles were completely paralysed. The absence of the reflexes and the complete flaccidity of the muscles suggest the implication of the lumbar region of the cord as well as the upper dorsal, and if the value of this criterion be thought to be weakened by the fact that the reflexes can be abolished by a complete transverse lesion (Bastian and others), I think that here the gradual movement upwards of the upper limit of anæsthesia showing itself some days after the onset renders it certain that a wide spread rather than a strictly localised lesion was present.

The lesion of vision.—In this case the failure of vision was rapidly developed after twenty-four hours' pain in the head and

eyes, and it preceded by fifteen days the symptoms referable directly to myelitis. The left eye was affected first and the right eye one day later, and vision was almost completely lost from the first; that is, the patient could at no time do more than distinguish light from dark, and in that sense recognise outlines, though her apparent powers of vision varied a little from day to day. She was unable to distinguish colours. The optic neuritis which I have assumed in the title of this article to exist was not as a fact ever visible as such. Six weeks from the commencement of the illness, the discs were white at the edge, and in the fourth month there was pronounced optic atrophy, so that if an optic neuritis was the cause of the amblyopia, it was one situated not in the eye but behind it, that is, it was a retro-bulbar optic neuritis. This, of course, is a well recognised affection, of which in its chronic form tobacco amblyopia is now known to be the result. Of the condition in its acute form the following account is given in a recent work on Ophthalmology¹. "The acute form of retro-bulbar neuritis is characterised by the suddenness with which the disturbance of vision develops; this failure of sight in the severe cases may attain such a degree in a few days that all perception of light is abolished. Externally the diseased eye looks normal; at most the pupil is dilated. The ophthalmoscope shows scarcely anything besides some distension of the retinal muscles. These symptoms are often accompanied by violent headache or by dull pain in the orbit, the latter being aggravated if the patient moves his eye, or if the attempt is made to push it back into the orbit." In a foot-note as to the ophthalmoscopic appearances, Fuchs says that "sometimes on the contrary ischæmia of the retina is present when the retinal vessels have undergone compression at the inflamed spot in the optic nerve." Thus it will be seen that in the rapidity of the development of the blindness, in the headache and pain in the eyes, the resemblance of the symptoms in my case to those of retro-bulbar optic neuritis is very close, though I have no note and do not remember any statement as to any condition which aggravated the ocular pain.

¹Text-Book of Ophthalmology. By Ernest Fuchs, translation by A. Duome, 1893, p. 439.

Then as to the ophthalmoscopic appearances, we have the report of Mr. Brailey to the effect that the condition was one of ischæmia retinae, which is one of the definite though less frequent results of the form of neuritis we are discussing. The subsequent atrophic state of the disc is what must come on in cases which do not recover their vision. We may conclude, then, that the patient had an optic neuritis, which was retro-bulbar and not intra-ocular in position. If we consider other cases it appears that a visible optic neuritis affecting the papilla is the more usual occurrence. Katz^a analysing twenty-one cases, says that the ophthalmoscope, in cases of combined optic neuritis and myelitis, generally shows a swelling or hyperæmia of the optic disc, coiling vessels and obscured margin, but the ophthalmoscopic results may be negative. Only twice was there an affection of the retina—once a spotty appearance of the fundus, and in the periphery pale bright spots and fine pigmentation. In another case the retina was veiled, the colour-reflex still visible but not distinct, some yellow-grey small spots on the retina and a brilliant point below. In the majority of cases both eyes are affected, and the loss of vision is absolute. In one of Dreschfeld's cases there was optic neuritis with no disturbance of vision.

The relations between the ocular and spinal lesions.—The ocular lesion has been attributed (1) to a meningitis ascending from the spinal cord, (2) to the agency of the sympathetic nerve, (3) to a local encephalitis, and (4) to a septic influence operating upon the optic nerve and the spinal cord at or about the same time. An important fact in this connection is the great frequency with which the visual symptoms precede those of spinal disease. The present case is a good instance, for fifteen days elapsed between the first occurrence of failure of sight and the first indication of paralysis of the legs, and even fourteen days before the paralysis the patient could not see at all. Katz shows that of twenty-one cases, in fifteen the optic neuritis preceded the myelitis at intervals varying from three days to five months; in five cases the spinal and ocular lesions occurred simultaneously; and in one only was the optic neuritis observed four or five weeks later than the myelitis.

Loc. Cit.

These facts are a serious difficulty in the way of the second explanation above suggested, and, moreover, in some post-mortem examinations, spinal meningitis has not been present, and in some in which the optic nerve was examined, the inflammation was situated at the centre and not at the periphery of the nerve-trunk. No material evidence has hitherto been advanced in favour of the sympathetic share in this connection, and the cervical part of the cord is certainly the region which is least often involved in the inflammatory changes. The most probable view is that the two lesions are the results of some infectious agent operating upon the parts simultaneously.

A definite infectious disease has occurred beforehand in a certain number of the cases. Sore throat was present in one case, influenza in another; syphilis was an antecedent in five of the twenty-one cases analysed by Katz; it was excluded in ten others. Lastly, more than one writer suggests the possibility that it may be regarded as an acute variety of sclérose en plaques or disseminated sclerosis; but it does not appear to me as yet that this position can either be proved or disproved. Against it is the much more marked limitation of the disorder to certain parts of the nervous system, namely, the optic nerve and the dorso-lumbar cords, than obtains in ordinary cases of cerebro-spinal sclerosis. Another point is that of two writers who have entertained this suggestion (Katz, Devic), neither has been able to point out a case in which the acute disorder under consideration has developed into a typical sclérose en plaques. It is well known that cases of the latter disease do sometimes begin with acute symptoms, and optic neuritis and atrophy are recognised occurrences in disseminated sclerosis. But our patient, M. M. P., who was the subject of optic neuritis, was under our observation for more than twelve months without showing any of the three cardinal symptoms of disseminated sclerosis, viz., intention tremors, staccato speech, and nystagmus, and she died a month after leaving us.

A word may be said as to prognosis and the outcome of the disease. It is not nearly so serious as from the nature and extent of the lesions one would expect it to be. Noyes, who has

recorded a case,³ writing of the combination of optic neuritis in his text-book,⁴ says, "All the cases have gotten well, both in respect to sight and to the functions of the cord." But the outlook is not quite so good as this statement would imply. Cases published by Katz, Devic, Dreschfeld, my own case, and others have been fatal. Devic found that four cases were fatal in sixteen which he analysed.

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THE ÆTIOLOGICAL SIGNIFICANCE OF THE DIPHTHERIA BACILLUS AND ITS VARIANTS.

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THE boundaries of the domain of diphtheria have been greatly widened, since the introduction of the bacteriological method of diagnosis, by the inclusion of cases not presenting the ordinary clinical characteristics of the malady; whilst in another direction they have been restricted by the exclusion of a number of conditions, which on clinical grounds would be classified as diphtheritic, but which scientifically cannot be so regarded, *i.e.*, where repeated examinations fail to reveal the existence of the Klebs-Loeffler bacillus. The bacteriological test has become more and more widely adopted, and in many quarters its verdict is considered as final. Judging from a study of current medical literature, however, there has been of late a growing tendency to question its exact value, and doubts have even been freely expressed by capable authorities as to its power to afford any substantial aid to the clinician.

The presence or absence of Loeffler's organism would form a most satisfactory criterion as to the nature of any suspected instance of diphtheria, and as to the possibility of the patient being a source of infection, were it not for the existence of certain difficulties of a fundamental nature. In the first place, we are met on the threshold of the subject by the uncertainty of differentiating the microbe which is the *causa causans* of the malady from sundry non-pathogenic diphtheria-like bacilli which are found both in healthy and diseased throats, and which differ morphologically from the true organism only in very insignificant and apparently inconstant features. In the second place, bacilli morphologically and culturally *indistinguishable* from the Klebs-Loeffler organism, but which are also definitely non-pathogenic to ordinary laboratory animals, are met with in anginas of different types, in the throats of presumably healthy individuals, as well as in the fauces of patients who are recovering from an attack of (clinical) diphtheria. Are such anginas to be regarded as truly diphtheritic in nature, and are the subjects thereof to be considered as possible foci of infection so long as their buccal cavities harbour the parasite? Further, are we in reality in these cases dealing with a parasite at all, or is the organism in question merely an accidental inoffensive saprophyte like the *streptothrix buccalis* and the *spirillum sputigenum*, which are now looked upon as normal inhabitants of the human mouth?

These questions have hitherto proved grave stumbling-blocks in the way both of bacteriologists and physicians, and it is to the elucidation of the exact ætiological relationship of the various diphtheritic and "pseudo-diphtheritic" microbes that the work detailed in the present paper has been devoted.

It is obvious that the problems connected with the subject possess a high practical as well as theoretical importance. For example, the usual routine procedure in many fever hospitals both in England and on the Continent is to detain and regard as "infectious" all patients, who, having passed through an attack of diphtheria, still present Klebs-Loeffler bacilli in the fauces. If, however, the so-called "pseudo-diphtheria bacillus" (Hofmann's bacillus) only is found, the patients are discharged. Similarly it

is becoming the rule to regard as non-diphtheritic—and therefore not to notify or isolate—patients from whom the pseudo-organism alone can be cultivated, though this practice has not yet obtained universal recognition. Again, in certain individuals the diphtheria bacillus persists in the throat for months and even years¹ after recovery from the disease, and the question arises as to the length of time it is necessary to isolate such persons before they cease to be dangerous to others. Many authorities have advocated the inoculation test in all doubtful cases, believing that if the isolated organism proves virulent to the guinea-pig, then rigorous separation and disinfection should be enforced, and the patient should be considered unclean so long as a pathogenic organism exists in the fauces. On the other hand, should the supposed diphtheria-microbe be completely non-virulent to small animals, these authors would give the suspect a clean bill of health and regard him as non-infectious. The question of confining convalescents and apparently healthy individuals for prolonged periods, because they continue to present diphtheria or diphtheria-like bacilli in their throats, is a serious one from the point of view of public hospital administration, as well as on other grounds. If the experimental test is capable of settling the difficulty, it must be welcomed as a valuable supplementary method of diagnosis.

In the following pages we shall endeavour to show that the proposed means of differentiation furnishes us with no additional useful information whatever. We shall demonstrate that neither (1) the morphological character, nor (2) the virulence, nor (3) the toxin-forming power of a diphtheria bacillus, bears any constant relation to the clinical nature of the case from which it has been isolated; and that all diphtheria-like bacilli (including the

¹ Washbourn and Hopwood (*Brit. Med. Journ.*, 19th Jan., 1895, p. 121) have published a case in which the diphtheria bacillus remained in the throat after an attack for sixty-three days; Schäfer (*ibid.*, 12th Jan., 1895, p. 61) another where it persisted for seven and a-half months; Legendre and Pochon (*Bull. de la Soc. Méd. des Hôp.*, 13th Dec., 1895, p. 815) for over two years; Hewlett (*Lancet*, 8th Feb., 1896, p. 357) for twenty-two weeks; Fibiger (Berlin Klin. Woch., No. 37, 13th Sept., 1897, p. 808) for four, six, and nine and a-half months respectively; Golay (*Rev. Méd. de la Suisse Rom.*, 20th Nov., 1897) for three hundred and sixty-two days; Simonin and Benoit (*Rev. de Méd.*, 10th Jan., 1898, No. 1., p. 60) a number of instances up to one hundred and twenty days.

pseudo or Hofmann organism) are really only varieties of the same species, because even the non-virulent forms can by appropriate treatment be converted into actively pathogenic and typical Klebs-Loeffler bacilli.

In order to contrast our conclusions with the generally accepted views, we shall first give a brief résumé of the literature bearing on the subject.

Klebs in 1883 signalized the presence of a special bacillus in cases of diphtheria, and described its disposition in the false membranes. In the following year Loeffler,² who had investigated twenty-five cases and had identified Klebs' organism in the greater number, was able to isolate it in a pure culture. He usually found it in association with other microbes, but in six of the cases the first cultivation from the throat gave pure colonies. By injection into animals of cultures after several generations he was able to reproduce in pigeons, fowls, and guinea-pigs the false membranes characteristic of the disease, together with all the accompanying constitutional symptoms, with the single exception of the post-febrile paralysis. Loeffler did not, however, absolutely prove the specificity of his bacillus, for Talamon³ had previously shown that it was possible with different microbes (*e.g.*, the staphylococcus) to excite on the mucosa of animals a diphtheroid exudation. In a second communication⁴ three years later, Loeffler reported that he had isolated the bacillus in ten new cases, and further stated the fact that in the false membranes there sometimes existed an organism very like the true diphtheria-bacillus, but differing in being slightly smaller and in having no pathogenic effects on animals. This species he termed the "pseudo-diphtheria bacillus."

The next article of any importance was that of Hofmann⁵ in 1888, who drew attention to an organism he had met with in the

² Mittheilungen aus dem Kaiserlichen Gesundheitsamte. Bd. II, 1884, p. 421. "Untersuchungen über die Bedeutung der Mikro-organismen für die Entstehung der Diphtherie beim Menschen, bei der Taube, und beim Kalbe."

³ Le Progrès Méd. 1881, p. 123 and 498.

⁴ Berlin, Militarärztl. Gesellschaft, Sitzung von 21 April, 1887, Ref. in Centralbl. für Bakt. 1887, Bd. II, p. 105. "Weitere Untersuchungen über die Diphtheriebacillen."

⁵ Wiener Med. Woch., 1888, Nos. 3 and 4, p. 65 and 107.

false membranes side by side with the Klebs-Loeffler bacillus, to which it possessed a close resemblance, but from which it differed in being non-virulent. He had found this microbe also in the anginas of scarlatina and measles. Hofmann laid stress on the great variability of the pathogenic powers of Loeffler's supposed specific bacillus, ascertaining that in certain cases the isolated organism was inoffensive to guinea-pigs, whilst in others it killed young but not old pigs, and in others again it was highly virulent for all individuals of this species. He distinguished the pseudo-diphtheria bacillus by the following points:—It was shorter, altogether more uniform in appearance, and did not show the differential staining of the protoplasm with methylene-blue, which is such a striking feature of the true organism; the colonies of blood-serum were of a purer white colour: the minimum culture temperature was lower; and the growth on agar was more active.

Shortly after Hofmann's paper, appeared the decisive communication of Roux and Yersin.⁶ These observers, in addition to confirming all Loeffler's work, were able to obtain from filtered broth cultures the poison produced by the diphtheria bacillus. This, when introduced into susceptible animals, in proportion to the dose injected, either killed rapidly with all the symptoms of the disease, or gave rise to typical post-febrile paralysis *without the direct participation of the microbe*.⁷ The final touch to Roux's work on the ætiological relationship of the Klebs-Loeffler bacillus was added in 1891 by Sidney Martin,⁸ who extracted from broth-cultures, as well as from the spleen and liver of patients who had

⁶ "Contrib. à l'étude de la diphthérie." Ann. de l'Inst. Pasteur, Dec., 1888, T. II. p. 629.

⁷ It is necessary at this point to emphasise the difference between the "virulence" or "infective power" of the diphtheria bacillus and its "toxigenic" power. By the former term we mean the capacity possessed by any given microbe to excite its specific effects when a *toxin-free culture* is inoculated into a susceptible animal. By the latter term is implied the power of an organism to secrete in artificial media (such as beef-broth) a soluble chemical poison, which by injection in the *germ-free state* reproduces the disease. The importance of this distinction resides in the facts, ascertained by us, that a non-virulent bacillus can sometimes be induced to elaborate a comparatively potent toxin, whilst a highly virulent organism, under the same conditions may secrete none at all.

⁸ Rep. of Med. Off. to Local Govt. Bd. (Supplementary Rep.), 1891, p. 147.

died of the disease, certain albumoses, which, by injection in small and repeated doses into rabbits, produced emaciation and paralysis, terminating in death. In these animals, peripheral neuritis and fatty degenerative lesions of the organs were found, exactly as occurs in the human subject after an attack. Lately, Roger and Bayeux⁹ have shown that extensive false membranes can be excited upon the laryngeal and tracheal mucosa of animals by the local application of the pure germ-free toxin; whilst Morax and Elmassan¹⁰ still more recently have induced typical diphtheritic conjunctivitis by the instillation of toxin into the eyes of rabbits. The latter facts indicate that even the formation of the characteristic local lesion can occur without the direct intervention of the bacillus.

To return to the distinguishing marks of the bacilli found in diphtheria. In 1888, Roux and Yersin¹¹ showed that the Klebs-Loeffler organism, when grown in neutral or slightly alkaline broth, rapidly turned the medium acid, but that after a longer or shorter interval the liquid again became alkaline. Zarniko¹² in 1889 was the first to point out that bacilli agreeing in characters with the pseudo-diphtheria organism of Loeffler and Hofmann produced no acid in neutral media, but, on the contrary, turned the bouillon alkaline from the very start. This observation has been confirmed by Escherich,¹³ Koplik,¹⁴ Cobbett and Phillips,¹⁵ Prochaska,¹⁶ and more recently by Hewlett and Knight.¹⁷ Neisser,¹⁸ however, finds that some pseudo-organisms produce acid, though in smaller amount than the true bacillus, and a delicate quantitative estimation is required to detect the difference.

⁹ *Compt. Rend. de la Soc. de Biol. T. IV.*, 19 March 1897, p. 265. "Sur la rôle de la toxine diphtérique dans la formation des fausses membranes."

¹⁰ *Ann. de l'Inst. Pasteur. T. XII.* March, 1898, p. 210. "Action de la toxine diphtérique sur les muqueuses."

¹¹ *Loc. cit.*, p. 633.

¹² *Centralbl. für Bakt. Bd. VI.*, 1889, p. 224.

¹³ *Ibid.* Bd. VII., 1890, p. 8.

¹⁴ *New York Med. Journ.* 1894, p. 300.

¹⁵ *Journ. of Path. and Bacteriology.* 1896. Vol. IV. No. 2, p. 193.

¹⁶ *Zeitschr. für Hyg. Bd. XXIV.* 1896. P. 391.

¹⁷ *Trans. of Brit. Inst. of Prevent. Med. 1st Series.* 1897. P. 12.

¹⁸ *Zeitschr. für Hyg. Bd. XXIV.* 1896. Heft. 3. P. 443.

In 1890 Roux and Yersin¹⁹ published a fresh study of the question, and discussed the significance of Hofmann's bacillus. They had generally met with it in "simple" anginas, and they found it in twenty-six out of fifty-nine children at a school where for some time there had been no diphtheria, as well as in fifteen out of fifty-five children in the general or non-infectious wards of the Hôpital des Enfants-Malades. They also discovered fully virulent diphtheria bacilli in the throats of a few healthy persons. They showed that pathogenic Klebs-Loeffler bacilli could be deprived of virulence by cultivating in broth for a month at a temperature of 39.5° C. The attenuated organism was now found to have lost certain of its ordinary characters, and "ce microbe artificiellement préparé se confond avec le pseudo-diphthérique." They were unable to restore the pathogenicity to bacilli which had been completely attenuated, but feebly virulent organisms regained their full activity when injected into animals together with the streptococcus.

In 1892 L. Martin²⁰ described three forms of true diphtheria bacilli in accordance with the morphological appearance :—

- (1) The long ("bacilles longs, intriqués, enchevêtrés.")
- (2) The short ("petits bacilles courts, disposés parallèlement les uns aux autres.")
- (3). The medium ("bacilles de moyenne longueur, se disposent parallèlement.")

He remarked on a difference of virulence in these forms corresponding to the relative length of the bacilli, viz., the long forms are the most virulent ("les plus toxiques,") the short forms least so ("très bénin"), whilst those of medium size are also intermediate in activity. He further stated that the most malignant cases furnished the long variety, the mild cases the short form, and those of average severity the intermediate sizes.

In 1894 Parke and Beebe²¹ classified diphtheria-like bacilli into three groups :—

- (1) Virulent and typical Klebs-Loeffler organisms, characteristic in growth and producing acid in bouillon.

¹⁹ Ann. de l'Inst. Pasteur, 1890. T. IV. p. 409.

²⁰ Ann. de l'Inst. Pasteur. 1892. T. VI. p. 339.

²¹ New York Medical Record, XLVI, 1894. p. 385.

(2) Bacilli morphologically and culturally identical with (1) producing acid in bouillon, but non-virulent.

(3) Bacilli not possessing all the characteristics of the Klebs-Loeffler organisms in growth, producing alkali in bouillon, and having no virulence.

They considered that of the latter group those which were uniform in size, shape, and staining, which showed no polar granules, produced an alkali instead of an acid, and induced no ill-effects in animals, were the only ones which could be easily and distinctly separated from the genuine Klebs-Loeffler form. They believed that these had no casual relation to diphtheria, and that they were the only species to which the appellation of "pseudo-diphtheritic" properly applied. They affirmed that group (2) comprised attenuated or degenerated Klebs-Loeffler bacilli, which had lost their virulence.

In the same year, Washbourn, Goodall, and Card²² in an examination of eighty cases adopted Martin's nomenclature, and stated that "it would appear that the short variety is the least virulent, and the medium variety is less virulent than the long."

In 1896 Peters,²³ in an elaborate paper, distinguished the following species :—

- (1) Long pathogenic bacilli (typical Klebs-Loeffler).
- (2) Short pathogenic bacilli.
- (3) Short non-pathogenic bacilli (Hofmann).
- (4) Long non-pathogenic bacilli resembling (1) in aspect.

He concluded that there were two morphological varieties of pathogenic bacilli, the long and the short, the latter being found only in mild cases of the disease. These two species were "immutable," *i.e.*, could not be converted one into the other. Hofmann's bacillus was to be met with in mild non-infective anginas, and it is a species quite distinct, and not derived by attenuation, from the true diphtheritic organism.

In the same year Cobbett and Phillips²⁴ brought forward a classification of diphtheria-like organisms, which was practically that of Park and Beebe. They thought that the question of the

²² *Brit. Med. Journ.* 22 Dec. 1894. p. 1417.

²³ *Journ. of Path. and Bacteriology.* Dec. 1896. Vol. IV., p. 181.

²⁴ *Ibid.*, p. 214.

relationship of the three groups "must at present remain an open one." They considered, however, that the pseudo-bacillus differed from the Klebs-Loeffler in so many respects that provisionally they "were inclined to regard it as a totally distinct species."

In 1897 Neisser²⁵ introduced a new method, which he claimed was capable of distinguishing the true bacillus from all allied non-specific pseudo forms. This consisted in staining a very young culture (ten to twenty hours old) first with strongly acid methylene blue, and then with vesuvin. All genuine diphtheria bacilli show polar colouration after this treatment, whilst the spurious varieties are uniformly stained.

Spronck²⁶ considers that the pseudo-bacillus is a totally different organism from the Klebs-Loeffler, and that it has nothing to do with diphtheria. He thinks, however, that neither the macroscopic nor the microscopic appearances by themselves are sufficient to allow of a diagnosis being made between the two species, and that the inoculation of an animal is indispensable for a correct determination. If the organism is found to be entirely non-pathogenic to the guinea-pig, the disease is definitely not diphtheria. He finds that in the latter animal Hofmann's bacillus merely excites a slight local œdema, and that this is not neutralized by anti-toxic serum. He therefore lays down the dogma that if the œdema excited by a suspicious diphtheria-like organism can be prevented by the prior administration of serum, then the microbe is an attenuated non-lethal variety of the Klebs-Loeffler bacillus, but if it is not neutralized then the organization is a pseudo, or Hofmann's bacillus, and the case is not one of diphtheria.

Fränkel²⁷ believes that all the methods hitherto employed, including the agglutination test, are insufficient to distinguish with certainty between the true and false bacillus, because the morphological and cultural appearances are not constant. He accepts Spronck's position as to the non-specific nature of Hofmann's organism, and he has confirmed his statement that œdema produced by the pseudo-bacillus cannot be prevented by serum. He

²⁵ *Zeitschr. für Hyg.* Bd. XXIV., 1896. Heft 3, p. 443.

²⁶ *La Semaine Méd.* 20 Sept., 1897, p. 353.

²⁷ *Berlin. Klin. Woch.* 13 Dec., 1897, p. 1087.

looks upon the inoculation of animals as the only absolute or final test, though he has found Neisser's new stain to be an exceedingly good means of separating the two forms.

Glucksmann's observations²⁸ lead him to believe that the grouping of diphtheria bacilli according to size and length is of no ætiological importance, as the precise morphological characteristics depend upon the conditions (*e.g.*, nature of pabulum, temperature, etc.) under which the particular organism has developed. "Mit der Aenderung der Bedingungen kann man andere Formen bekommen."

Hewlett and Knight²⁹ consider that there are all intermediate links between the typical and virulent Klebs-Loeffler and the Hofmann bacillus. They declare, however, that the latter differs from the former in morphology and staining reaction, by producing alkali instead of acid, by giving a visible growth on alkaline potato, and by not growing anaerobically. By a complicated method of alternate growth on blood-serum and in bouillon, followed by passage through a guinea-pig, they succeeded in converting a non-virulent short bacillus of the Hofmann type into a pathogenic organism exhibiting all the characteristic features of the Klebs-Loeffler group. They consequently affirm their belief that "the pseudo is sometimes a modified Klebs-Loeffler bacillus, though perhaps not always, as possibly more than one species having the same morphology may exist."

Schanz³⁰ on various grounds believes that the Klebs-Loeffler, the Hofmann, and the xerosis bacillus³¹ are really one and the same species, the latter two representing saprophytic varieties of the former. He brings forward facts and arguments discrediting Neisser's method of differentiation, and states that Loeffler himself places no reliance on it. According to Schanz Loeffler now holds that the only characteristic and reliable distinction (durch-

²⁸ *Zeitschr. für Hyg.* 1897. Bd. XXVI. Heft 3, p. 417.

²⁹ *Loc. Cit.*

³⁰ *Münch. Med. Woch.* No. 11. 15 March, 1898, p. 333, and *Deutsche Med. Woch.* 18 August, 1898, p. 522.

³¹ In the present paper we have not discussed the position of this remarkable diphtheria-like organism, because, as Schanz points out, it does not occur in the human throat, so far as it is at present known.

greifende Unterschied) between the true and false bacillus is in the power of forming toxin.

Wesbrook, Wilson, McDaniel, and Adair³² have recently described yet another " atypical " variety of the diphtheria bacillus. This organism is in size about equal to Martin's ' short ' form, is generally arranged in pairs, stains uniformly and deeply, and never shows polar granules. These authors distinguish it from the pseudo-bacillus solely by the possession of a definite and specific virulence towards guinea-pigs, which is neutralizable by antitoxin. This microbe was found in 77 children out of 478 at a State school where diphtheria was endemic, in 11 of these cases being associated with clinical diphtheria.

From the above summary of the views of those bacteriologists who have especially studied the subject³³ it can at once be seen that considerable confusion exists as to the exact significance of the different varieties of the true diphtheria bacillus, and especially as to the relations of the pseudo-organism to the disease. The confusion is accentuated by the application of the latter term in different senses by different writers. This fact is perfectly clear from a close study of the literature, and to reconcile the descriptions of the species enumerated by one writer with those of another is a work of no little difficulty, if not an impossibility. From an exhaustive experimental and clinical study of over 100 strains of organisms we have come to the conclusion that the elaborate and complex divisions and classifications hitherto laid down, whether based on grounds of morphology or pathogenicity, have no real foundation in the nature of things.

Our material has been chiefly obtained from patients at the Brook Fever Hospital, Shooter's Hill, but a certain number of organisms were kindly supplied by the Assistant House-Surgeons and House-Physicians at Guy's Hospital, and a few by private practitioners (Dr Jones of Harrow, Dr. Goddard of Wembley,

³² *Brit. Med. Journ.* 16th April, 1898. P. 1008.

³³ Besides the works quoted, other authors (Beck, *Zeitschr. f. Hyg.* Bd. VIII, 1890, p. 434; Abbott, *Bull. of Johns Hopkins' Hosp.* 1891, p. 110 and 143; De Martini, *Contralbl. für Bakt.* Bd. XXI, 1897, p. 87; Kresling, *Pharmaz. Zeitschr.*, ref. in *Centralbl. f. Bakt.* Bd. XXIII, 1898, p. 557; Zubnik, *ibid.* p. 660, etc.) have written on the question, but their contributions do not seem to us to require incorporation in the text of this paper.

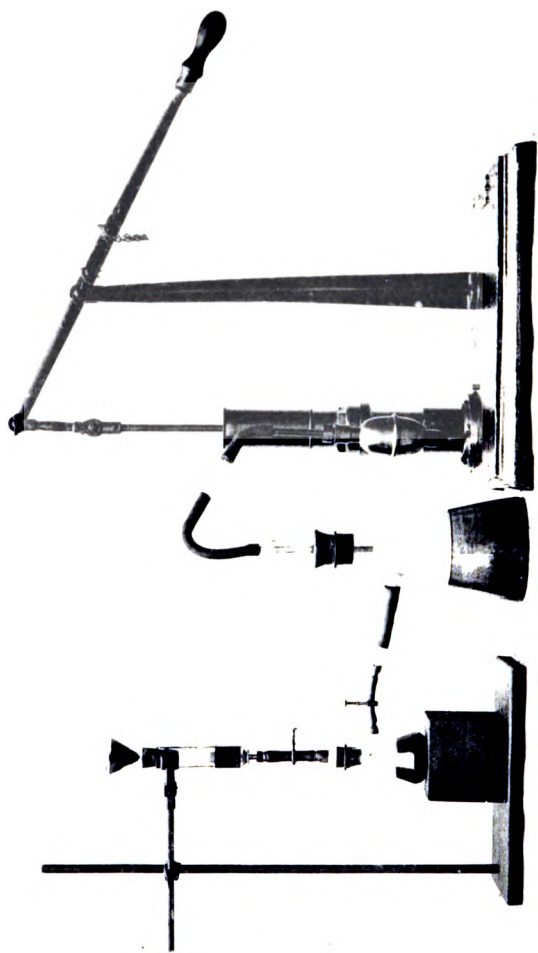
and others). In all instances a careful account has been kept of the exact clinical nature, course, and termination of the cases from which the organisms were isolated. The variety of bacillus (as regards its morphology) was always noted,⁸⁴ whilst the precise virulence and toxigenic power for guinea-pigs of each microbe was ascertained *quantitatively*. The methods adopted for determining the latter data were as follows:—

(a) *Virulence*.—With the swab taken directly from the throat of the patient in the usual routine manner two or three blood-serum tubes are successfully inoculated. Very often the last tube is found after fifteen to eighteen hours' incubation to give pure colonies of the bacillus, and in any case a pure growth is readily obtained by sub-culturing. The activity of the organism is then estimated by determining the least quantity *by weight* of a twenty-four-hour blood-serum culture which will suffice to kill a guinea-pig, of about 500 gm. In order to obtain the different experimental amounts we use platinum wire loops, made so as to hold when full exactly 0.5 mgm., 2 mgm., and 3 mgm., of culture respectively.⁸⁵ One of these loops is sterilized in the flame, placed lightly upon the surface of the serum, and as soon as the little circle is filled, it is withdrawn and the contents suspended in 2 c.c. of sterile distilled water contained in a small conical test-glass. The emulsion is now injected into a guinea-pig, beneath the skin of the abdomen, in the usual manner. When fractions of a milligramme less than 0.5 are required, all that is necessary is to add the contents of the smallest loop to 10 cc. of water, and to take corresponding fractions of this quantity.

(b) *Toxin secreting power*.—A few loopfuls of a serum sub-culture are planted in alkaline bouillon contained in an Erlenmeyer's flask. To ensure uniformity of conditions as far as possible, and to render all results strictly comparable, every flask used for the different organisms was of the same size (300 cc. capacity), and was filled to the same depth with the broth. The

⁸⁴ The nomenclature we have employed is that of L. Martin.

⁸⁵ The smallest of these loops was identical in construction with that employed for a similar purpose by Dr. Washbourn to determine the virulence of pneumococcus cultures. Vide *Journ. of Path. and Bacteriology*. Vol. v. Jan. 1898, p. 14.



Apparatus employed for preparing the toxins of the different diphtheria bacilli.

composition of the latter—a most essential factor—was also in all cases the same,⁸⁶ and followed Park and Williams' suggestions.⁸⁷ After incubation at 37° C. for seven days the culture is filtered through a miniature Berkefeld filter into an air-tight Kitasato's flask, the necessary vacuum being obtained by means of a Fleuss (pulsometer) oil-pump. (*Vide* photograph I.) With this apparatus all the bacilli are completely separated from the toxin, and are retained on the exterior of the earthenware candle, the clear germ-free poison alone passing into the filter-flask. Small quantities of the toxin for testing purposes are removed from the latter by a Pasteur pipette, and any required quantity can be measured in a graduated tube and administered to a guinea-pig.

The investigation of a large series of cases (114) in this manner was very tedious. The results are embodied in the accompanying table (p. 81) and may be epitomized as follows:—

(1) *The virulence of a diphtheria bacillus for guinea-pigs bears no relation to the severity or malignancy of the disease in the patient from whom the organism was derived.* Thus, 3 to 5 mgm. of culture was found to represent the average minimum lethal dose of most of the organisms in the series, and such organisms therefore we look upon as possessing "average" virulence. Now, although in a certain number of instances the activity of the microbe is seen from the table to correspond to the clinical nature of the case, yet some of the most virulent bacilli (Nos. 5, 26, 28, 39, 73, 109) came from the mildest cases; whilst several exceedingly severe and hopeless forms furnished an organism which was remarkably benign (Nos. 12, 25, 48, 56, 106, 112); and in three fatal cases the bacillus obtained proved non-virulent⁸⁸ (Nos. 51, 59, 99). These facts effectually dispose of Roux and Yersin's statements that "*Les diphthéries les plus anodines sont*

⁸⁶ On the importance of this point *vide* Madsen, Zeitschr. für Hyg., 1897, Bd. xxvi., Heft 2, p. 157 et seq. "*Zur Biologie des Diphtheriebacillus.*"

⁸⁷ *Journ. of Experimental Med.* Vol. I., 1896, p. 164. The broth was alkalized to the extent of 7 cc. of normal caustic soda per litre.

⁸⁸ Lemoine (Bull. de la Soc. Méd. des Hôp., 30 June, 1897, p. 875) has also published a case of great clinical gravity, from which a non-virulent diphtheria bacillus was isolated. Before deciding that these organisms were totally non-virulent, twenty-four-hour broth as well as serum-culture were tested.

celles qui ont donné les bacilles les moins actifs," and "le virus le moins actif se rencontre dans les cas les moins graves."

(2). *The power possessed by the bacillus of secreting toxin in artificial media bears no relation to the clinical nature of the disease in man.* Most of the potent toxins (Nos. 16, 19, 26, 38, 83, 93) we met with in the series were fabricated by organisms coming from quite mild cases, while the bacillus from several grave cases secreted little or no toxin at all, 2, 5, or more cc. being required to kill (Nos. 12, 56, 65, 91, 99, 103, 105). Case 4, however, presenting markedly severe local and constitutional symptoms, yielded a microbe of extraordinarily active toxigenic powers, 0.01 cc. killing guinea-pigs easily in four days.

(3). *The virulence or infective power of any given diphtheria bacillus bears no necessary or constant relation to its toxigenic power.* (N.B.—Nos. 5, 19, 20, 27, 31, 62, 72, 80, 90, 106). The fact has previously been noted by other observers that very virulent bacilli by no means always furnish strong toxin.

Thus, Roux³⁹ in 1894 makes the following statement:—"Tous les bacilles diphthériques, même lorsqu'ils paraissent également virulents pour les cobayes, ne donnent pas les mêmes quantités de toxine dans les cultures." Aronson⁴⁰ arrived at the same conclusion, whilst Ernst⁴¹ says, "Several different virulent organisms which we tried, coming from cases of great severity, seemed to have no power whatever of forming toxin." Our results entirely confirm these observations, and in addition bring out a new fact, viz.: *that totally non-virulent bacilli can secrete a comparatively powerful poison* (Nos. 51, 55, 23, 32, 93, 108). This is certainly a most remarkable circumstance, the exact significance of which is not quite obvious.

Apparently only a very few strains of the diphtheria bacillus (No. 4 alone in our series) possess the property of elaborating their poison in artificial media in a high degree of concentration, i.e., of a killing power equal to or greater than $\frac{1}{100}$ cc. Theobald Smith and Walker,⁴² amongst a small number of toxins which

³⁹ Ann. de l'Inst. Pasteur, 1894. T. VIII., p. 612.

⁴⁰ Berlin Klin. Woch., No. 18, 30th April, 1894, p. 426.

⁴¹ Trans. Assoc. Americ. Phys., 1895. Vol. X., p. 299.

⁴² 28th Ann. Rep. of the State Board of Health, Mass., U.S.A., 1896, ref. in Centralbl. für Bakt. Bd. XXII., Heft. 13, 31 March, 1898, p. 555.

they examined, found that the average strength did not exceed $\frac{1}{12} - \frac{1}{15}$ cc. In our 114 cases the average toxicity is not greater than $\frac{1}{8} - \frac{1}{10}$ cc. It is on account of the difficulty of finding a highly toxigenic stock that every antitoxin station in Europe, until recently, made use of subcultures of the same bacillus for manufacturing the poison on a large scale. This organism was originally obtained by Behring from a case of diphtheria in Norway, and it formed toxin in favourable media, killing guinea-pigs at $\frac{1}{75} - \frac{1}{100}$ cc. The most toxigenic species yet recorded was one found by Park and Williams⁴³ of New York, and is now spoken of as "le bacille Américain." It originally produced a poison, the lethal power of which was represented by $\frac{1}{200}$ cc., but it has been exalted at the Pasteur Institute⁴⁴ until at the present time it kills at $\frac{1}{500}$ cc.

(4) *No relation exists between the length of the bacillus and (a) the severity of the disease in man, or (b) its virulence for guinea-pigs.* Thus we have obtained very short bacilli (the "très benin" of Martin) from desperate and fatal cases (Nos. 4, 11, 12, 31, 101, 105), as well as from others of mild or average severity (Nos. 2, 5, 22, 44, 54, 100). Long bacilli have been found in the mildest possible conditions (Nos. 7, 8, 16, 28, 43, 53, 82, 83, 109), and also in malignant or hæmorrhagic forms (Nos. 13, 14, 21, 48, 51, 52, 56, 99). Similarly, organisms of medium length have been met with in cases of every grade of severity. Again, long bacilli are often only weakly pathogenic to guinea-pigs (Nos. 7, 34, 42, 53, 56, 69, 80, 113), and sometimes totally non-virulent (Nos. 51, 88, 99), whilst some very short bacilli are highly active (Nos. 4, 5, 31, 73, 87, 90, 100), and vice versâ.

(5) *The same facts apply, mutatis mutandis, to the toxigenic function.* We can say definitely that the latter has no relation whatever to the morphological appearances, and that comparatively potent toxins are obtainable from both long and short bacilli. On the other hand, many long as well as short and medium bacilli fabricate practically no poison at all in artificial media (Nos. 6, 9, 36, 88, 99, 103).

⁴³ *Journ. of Experim. Med.*, Vol. I., 1896, p. 168.

⁴⁴ *Ann. de l'Inst. Pasteur.* T. XII., Jan. 1898, p. 42.

We have worked for a considerable time both with the Behring-bacillus and the Park-Williams-organism above referred to. The former of these highly toxigenic microbes is a very short rod, hardly to be differentiated in appearance from the pseudo-variety, whilst the latter presents an extremely elongated form, and is one of the largest bacilli we have ever seen.

(6) Bacilli agreeing in morphological and cultural characters with the pseudo-diphtheria bacillus of Loeffler and Hofmann are generally, but *not always* (e.g., Case 46) non-pathogenic to guinea-pigs. As a rule also they are incapable of secreting a toxin which is harmful to rodents, though we have met with one (No. 55) which elaborated a small quantity of a lethal poison. They are generally, but *not always*, (Case 59), derived from mild cases of the disease. Thirteen out of fifteen pseudo-diphtheria bacilli met with in the series were both non-virulent and non-toxic.

These microbes, though harmless to guinea-pigs, we have found to be highly virulent for most birds of the finch and bunting families. It seems to us, therefore, entirely erroneous to describe them as "non-pathogenic," especially as by successive passages through certain of these creatures (*Carduelis elegans*, *Fringilla coelebs*) we have been able ultimately to render them capable of killing both guinea-pigs and rabbits.⁴⁵ Similarly, although filtered cultures of the pseudo-diphtheria bacillus produce no ill-effects in guinea-pigs, yet they are toxic to small birds. During the transmutation of one form into the other we have found that the pseudo-bacillus gradually changes its morphological and biological characters, becoming longer, staining differentially with methylene-blue or bleu de Roux, and ultimately forming acid in neutral broth. On one occasion a Hofmann bacillus, originally measuring 1μ , attained a length of 3μ after six passages through the goldfinch; and although before exaltation two whole serum cultures of this organism remained without effect upon the guinea-pig, yet eventually a few loopfulls of culture from the sixth bird killed guinea-pigs with all the pathognomonic signs of experimental diphtheria (local gelatinous effusion, suprarenal reddening,

⁴⁵ The conversion of the one bacillus into the other can be effected with ease by the well-known Pasteurian method. The full technical details of the process will be published by one of us in another place.

pleuritic exudate, etc.). The so-called *pseudo-diphtheria bacillus* can henceforth, therefore, only be regarded as a mild and attenuated, but still pathogenic, variety of the true causal agent of diphtheria.

All the fifteen pseudo-bacilli isolated in our series of cases, as well as four obtained from other sources, were examined in relation to their pathogenic action upon various species of birds. Just as the ordinary laboratory mammals (mice, rabbits, guinea-pigs, dogs, etc.) present differences of susceptibility to the fully virulent Klebs-Loeffler bacillus according to the species, so in like manner do the Merulidæ, the Fringillidæ, the Emberizidæ, etc., amongst the Aves towards Hofmann's organism. Thus, while all of the latter we have tested have been capable of killing the canary (*Serinus canarius*), the goldfinch (*Carduelis elegans*), the hedge-sparrow (*Accentor modularis*) and the chaffinch (*Fringilla cœlebs*), only one exerted any effect upon the linnet (*Linota cannabina*) and the greenfinch (*Coccothraustes chloris*); whilst the blackbird (*Turdus merula*), the thrush (*T. musicus*), and the starling (*Sturnus vulgaris*) appear to be highly resistant to every variety, though they succumb readily if infected with a culture exalted by three or four passages through a more susceptible bird.

Further, just as we have seen that certain strains of the Klebs-Loeffler bacillus are much more virulent towards the guinea-pig than others, so the pseudo-bacilli differ amongst themselves as to their activity towards any given species of bird. For example, 20 mgm., 10 mgm., and half a serum culture respectively, represented the minimum lethal dose of three different organisms for the hedge-sparrow, whilst 2 mgm. and 10 mgm. were the fatal doses for the chaffinch of two other strains. There are to be met with, therefore, diphtheritic organisms of every grade of virulence, the weakest, known as Hofmann's bacillus, representing the most attenuated form of the Klebs-Loeffler bacillus, and being capable of killing only certain small birds. More virulent varieties can cause larger birds to succumb, whilst others still more virulent can kill certain of the rodents, such as the guinea-pig.

It seems satisfactorily demonstrated that the so-called pseudo-diphtheria bacillus is after all merely a variety of the true organism—attenuated and altered in form somewhat it is true, but none

the less the same species. As it can be converted artificially into the pathogenic form, it is in the highest degree probable that such conversion occurs naturally. The organism, therefore, whenever found, must be regarded as a *potential* source of infection. It is a different question, however, whether we are to consider a person who harbours the bacillus in his fauces as dangerous to the public health, because we do not know how or when the potentiality become an actuality : or, in other words, whether the organism transferred *directly* to a second individual is capable of causing harm. Judging by analogy it is quite possible that it might be necessary for it to pass through some intermediate stage, some life-cycle, outside the human body, before it re-acquires sufficient virulence to cause a true and infectious diphtheria. Evidence is available, however, which leads us to believe that the Hofmann bacillus *as such* can, under certain conditions, cause an infectious sore-throat transmissible directly from person to person. The data on this head come under four categories :—

(1). There is now a practically unanimous agreement on the observation, first brought into notice by Thorne Thorne in his Milroy Lectures, that a great many epidemics of diphtheria start as mild anginal conditions, the nature of which is for a time unrecognized, and which progressively become more severe as they pass from person to person, eventually culminating in a type of malignant diphtheria. This view is stated with confidence by Public Health authorities (Parkes,⁴⁶ Whitelegge,⁴⁷ Notter and Firth,⁴⁸ etc.) and it has been confirmed by the recent observations of Netter,⁴⁹ in a small epidemic at the Hôpital d'Aubervilliers, and of Simonin and Benoit⁵⁰ in an outbreak amongst the garrison at Lyons. Now, it is precisely in these early, mild, indeterminate cases, previously called "simple" angina, but now known by the name of "larval diphtheria" (Heubner, Baginsky, Simonin and Benoit), that the pseudo- or non-virulent short diphtheria bacillus

⁴⁶ Hygiene and Public Health. 1892, p. 437.

⁴⁷ Hygiene and Public Health. 1896, p. 299.

⁴⁸ Theory and Practice of Hygiene. 1896, p. 615.

⁴⁹ *Bull. de la Soc. Méd. des Hôp.* 15 February, 1895, p. 121.

⁵⁰ *Révue de Méd.* 10 January, 1898. No. 1, p. 48. "Il est un fait certain, c'est que les formes plus les bénignes peuvent se changer en diphthérie membraneuse."

is most often found. Indeed, all the writers on Hofmann's organism describe its presence in "mild" or "simple" sore throats (Park, Biggs, Peters, etc.). Simonin and Benoit, in their very important communication, showed that from all these cases a diphtheritic organism could be cultivated, generally of the short or "pseudo" type, which was non-virulent to guinea-pigs, but which would kill a small exotic bird, the "Calfat." Further, it was not until all persons in the garrison (including the apparently healthy) who presented this microbe in their throats were isolated, that the epidemic was stamped out.

(2). After an attack of acute diphtheria in which the Klebs-Loeffler bacillus is found, the latter is very often replaced during recovery by the pseudo-bacillus. Thus, Koplik⁵¹ obtained all his specimens of the latter organism from tonsils which had just previously been the seat of true diphtheritic inflammation. Peters⁵² states, as a result of his experience, that "it is very common to find Hofmann's bacillus in the chronic coryza following diphtheria," though he does not think that the pseudo-variety necessarily follows the Klebs-Loeffler "by rote." Hewlett and Knight⁵³ affirm that the pseudo generally becomes substituted for the Klebs-Loeffler in recovering cases—"Almost always the pseudo appears towards the end, the next examination revealing the absence of either diphtheria or pseudo-diphtheria bacilli." Sevestre and Méry⁵⁴ found that bacilli of the short non-virulent pseudo-type very frequently persist in the mouth for some time after an attack. Simonin and Benoit speak to the same effect, and our own observations, not only on the cases included in the series, but extending over several hundred patients systematically examined, are entirely in harmony with these statements. Now, there is an abundant clinical evidence to show that such convalescents are infectious, and in fact Sevestre and Méry, referring to these cases, say "Il nous paraît actuellement impossible de nier la possibilité de la contagion par les enfants convalescents

⁵¹ *New York Medical Journal*. LIX. 1894, p. 300.

⁵² *Loc. cit.* p. 190.

⁵³ *Loc. cit.* p. 17.

⁵⁴ *Bull. de la Soc. Méd. des Hôp.* 8 February, 1895, pp. 101 and 116.

de diphthérie, et présentant toutes les apparences du retour complet à la santé."

(3). Creswell⁵⁵ before the days of bacteriological diagnosis raised an important question in regard to persons who have at one time suffered from Diphtheria, and in whom tonsillitic attacks are often subsequently set up by trifling causes. He observed that amongst those associating with such people on these occasions diphtheria is very apt to arise without discoverable cause. He suggested that the chronic morbid condition might really be a latent form of diphtheria, the recrudescence of which became the starting point for the spread of infection. Legendre and Pochon⁵⁶ have published facts which throw a great deal of light on the question. For example, a child after having suffered from nasal diphtheria was subsequently subject from time to time to attacks of slight illness during which he became pale, "triste," lost appetite, and sometimes had mild angina. It was found that on these occasions he presented medium-sized diphtheria bacilli in the nasal mucus. As the attack passed off, the form of the organism gradually altered to the short non-virulent pseudo type ("par dégradation insensibles de son type classique") but with each recurrence of the illness it once more underwent a morphological change, and became longer. Vigorous antiseptic lavage and other local treatment caused the microbe to disappear for a short time, but always after a suspension of these measures the pseudo-bacillus returned in force, probably having been hidden away meanwhile in some crypt or deep mucous gland. At the moment when the communication was made, this condition of things had persisted for over two years. Here we have a case in which the "pseudo-organism" from time to time becomes capable of causing definite illness, simultaneously altering its biological characters. If it can excite such an affection in a subject already partially immunized by a previous attack, it seems pretty certain that if transferred to a fresh non-immunized person, serious diphtheritic symptoms might occur. The case, indeed, furnishes us with the key to Creswell's observation.

⁵⁵ Trans. of Epidem. Soc. N. S. Vol. v., 1885-6, p. 57.

⁵⁶ Bull. de la Soc. Med. des Hôp. 13 December, 1895, p. 815.

(4). Finally, amongst our own series of cases we have had a small number (6) in which Hofmann's bacillus was found, *and which were distinctly infectious*. A limited outbreak of post-scarlatinal diphtheria occurred during convalescence amongst the patients in a scarlet-fever pavilion. There was unquestionable evidence that the infection started in one particular case, and that from this it was passed from patient to patient round the ward. In every instance the organism isolated from the throat was morphologically a typical Hofmann's bacillus, and in four of the cases it was non-virulent to guinea-pigs. In the last two, although the morphological features remain the same, it was found that in one the organism was slightly virulent to animals, and in the other that it formed small quantities of toxin, though a toxin-free culture did not affect guinea-pigs. Here there was no doubt that the "pseudo-diphtheria bacillus" caused a mild epidemic of clinical diphtheria, and that in the latter cases the organism, by passage through man, had become exalted for the guinea-pig.

All the evidence, then, points to the fact that the presence of the pseudo-diphtheria bacillus in the throat constitutes an individual a possible source of infection. It is no objection to this position to argue that, as the pseudo bacillus is to be met with in a very large number of healthy persons, and in patients suffering from divers non-specific maladies, diphtheria should be much more general and widespread than it is, if the Hofmann organism were a disease excitant. We would point out that very nearly, if not quite, as large a proportion of normal people present active and virulent Klebs-Loeffler as Hofmann's bacilli in their throats.⁸⁷

⁸⁷ Müller (*Jahrbuch für Kinderheilkunde*, Bd. xliii., 1896, Heft 1) found Klebs-Loeffler bacilli in 6 out of 100 children at the first examination, and in 14 more on further examination after the lapse of a few days. ("Untersuch. über die Vorkommen von Dip. bacillen in der Mundhöhle von nicht diphtherischen Kindern.") Aaser in a cavalry regiment (*Deutsch. Med. Woch.*, 30 May, 1895, p. 357) found the diphtheria organism in 17 out of 89 soldiers, *i.e.*, 19 per cent. Park and Beebe (*loc. cit.*) state that out of 330 persons examined at random 8 had fully virulent bacilli, and 24 "characteristic but non-virulent Klebs-Loeffler bacilli." Meade Bolton (*Med. and Surg. Reporter*, vol. lxxiv., 27 June, 1896, p. 799) amongst 214 healthy persons "who had been more or less exposed to diphtheria," found the virulent bacillus in 41·5 per cent. Westbrook and Wilson (*loc. cit.*) in 478 persons at a school found 36 per cent. of the whole number to show virulent diphtheria bacilli, typical or

Indeed, the ubiquity of the diphtheria bacillus at once suggests the question, "Why is diphtheria, as a clinical affection, not more common when so many individuals carry the *materies morbi* in their person?" Partly, no doubt, because "the majority of persons, and perhaps the majority of children, are not ordinarily very susceptible to the disease." (Park and Beebe, Hermann-Biggs). A fully satisfactory answer, however, cannot at present be given to the question. We only know that there are other factors involved in the ætiology of infectious diseases besides the mere invasion or "infection" with the specific organism; and as Petterkofer pointed out many years ago, in addition to the questions of the microbe and the resistance of the individual there is another influence at work, a *tertium quid*, of which we are at present totally ignorant. There can be no reasonable doubt that diphtheria is mainly diffused by personal infection, and indeed it is certain that, when any variety of diphtheria bacillus is found in the throat of a human being, whether normal or diseased, such person has at a previous period "caught" it directly, either from a diphtheritic patient with whom he has been in contact, or from some other "bacillusträgende" individual. As the result of an exhaustive and conscientious investigation of an epidemic at a large school at Herlufsholm, Fibiger⁵⁸ lays down this position very strongly. Müller⁵⁹ examined bacteriologically 100 children entering the general or non-infectious wards of the Charité in Berlin. Cultures were made from the throat on admission, and for several days subsequently. Amongst the 100 patients, six, on entry, had

atypical, and in 14 per cent. only their presence was associated with illness, *i.e.*, over 21 per cent. of all the healthy individuals showed Klebs-Loeffler organisms. Very many smaller series of figures showing similar results could be quoted. As regards the frequency of occurrence of the pseudo-bacillus in addition to the statistics of Roux and Yersin already mentioned, the following observations have been recorded:—Escherich (Berlin. Klin. Woch., 22 May, 1893, No. 21, p. 493) found it in 2 persons out of 70 in Munich, and in 11 out of 250 in Graz; Beck (Zeitschr. für Hyg., Bd. viii., 1890, p. 434) in 22 out of 66 healthy children, and in 14 out of 41 others suffering from non-diphtheritic affections; Abbot (Bull. of Johns Hopkins Hosp. October-November, 1891, p. 143) in 4 out of 53 cases; Park and Beebe (*loc. cit.*) in 27 out of 330 healthy persons.

⁵⁸ Berlin. Klin. Woch. No. 35, 30 August 1897, p. 753.

⁵⁹ Jahrbuch für Kinderheilkunde, Bd. xliii., 1896, Heft 1.

diphtheria bacilli without any symptoms, and in fourteen others the organism was found after a day or two's residence in the Hospital. He states that several times when bacilli had been found in a child admitted one day, the next day the children in the adjoining beds also furnished the organism, although they had previously been quite free and subsequently did not develop symptoms. Meade Bolton⁶⁰ affirms that of 214 perfectly healthy persons who had at some period been exposed to infection, no less than 41·5 per cent. showed Klebs-Loeffler bacilli in their throats, and he says that he found that always "more than one-third of all persons more or less exposed to contagion get the bacillus in their throats." Park and Beebe⁶¹ investigated how frequently healthy children became infected with the organism in families where one member is attacked with diphtheria. They examined the throats of forty-eight unaffected children in fourteen such families, and in over 50 per cent. of cases where no isolation was carried out the fully virulent bacillus was found. Amongst other families, where a case of diphtheria had occurred, and where isolation as perfect as possible was employed, 10 per cent. showed bacilli. Westbrook, Wilson, McDaniel and Adair⁶² also came to the same conclusion, and in consequence think it is necessary to carry out quarantine "by placing one patient in one room," because "children whose throats after isolation have become free from bacilli may become re-infected by others in whose fauces organisms are still present." Observations of our own upon the throats of 129 doctors, nurses, and medical students who had diphtheria patents under their charge, showed that the Klebs-Loeffler bacillus was present in no less than sixty-two, whilst from three out of five workers in the bacteriological laboratory bacilli were obtained which were highly virulent for the guinea-pig.

That these healthy "bacillusträgende" individuals may convey mortal diphtheria to others has been proved over and over again.⁶³

⁶⁰ *Medical and Surgical Reporter*. Vol. lxxiv., 27 June, 1896, p. 799.

⁶¹ Loc. cit. p. 396.

⁶² Loc. cit. p. 1011.

⁶³ Vide Netter (loc. cit.); Escherich (loc. cit.); Park and Beebe (loc. cit.); and especially Williams and Foulerton, *Lancet*, 23 October 1897, p. 1038.

Fibiger,⁶⁴ Aaser,⁶⁵ Feer,⁶⁶ Simoni and Benoit,⁶⁷ Wesbrook and Wilson,⁶⁸ and others have indeed found that endemicity or the continuance of an epidemic in isolated communities, such as residential schools or barracks, depends entirely upon the freedom to spread contagion by healthy bacillus-carriers; and they have demonstrated in practice that, not until all such persons are quarantined, will the epidemic cease.

It is quite clear, however, that the mere contact with Klebs-Loeffler bacilli, or their presence in the throat, is not *in itself* sufficient to account for the outbreak of actual disease. It is most probable in the case of the normal individual who harbours bacilli, that under ordinary circumstances, an equilibrium is established between the tissue-resistance and the pathogenicity of the microbe, and this equilibrium is maintained until the intervention of some external cause upsets the balance in favour of the parasite. It cannot be doubted that diphtheria is mainly diffused by personal infection, but nevertheless, personal infection does not explain why in some years diphtheria, though present in the district in endemic form, does not spread, whilst in another year in which exactly the same opportunities of personal infection presumably occur it become extensively epidemic. Still less does it explain the occurrence of widely-scattered and universal pandemics at certain periods, such as were witnessed in the quinquennium 1857-62. Neither can personal infection provide the key to the mystery of "seasonal" prevalence.⁶⁹ To explain these the operation of wider general causes than case to case infection must be assumed. We now know that epidemics of diphtheria never originate or continue in a "wet" year. "All the great epidemics originated in dry years, *i.e.*, years in which the total annual rainfall is materially below the average, and the most extensive epidemics have always occurred when there have been

⁶⁴ Loc. cit.

⁶⁵ Deutsche Med. Woch. 30 May 1895, p. 357.

⁶⁶ Ann. Suisses des Sciences Méd., quoted by Aaser. Loc. cit., p. 358.

⁶⁷ Loc. Lit.

⁶⁸ Loc. cit.

⁶⁹ The curve of seasonal prevalence always rises markedly in October and November, vide Whitelegge, Hygiene and Public Health, p. 294, and any work on State Medicine.

four or five consecutive dry years.”⁷⁰ Season, soil, site, the level of the ground water, the prevalence of scarlet fever,⁷¹ and other factors, have all been shown to exert some occult influence both upon the endemicity and epidemicity of diphtheria. The recognition of the importance of meteorological and such-like conditions in the ætiology of the affection implies that if we limit our enquiry into its origin and spread to a purely laboratory study of the diphtheria bacillus, we shall only continue to grope without getting much additional light.

These considerations, as Newsholme remarks, produce at first blush a feeling of helplessness. If the occurrence of epidemics and pandemics of diphtheria is governed largely by climatic and other conditions over which we have no control, and if, further, endemic prevalence depends on the fact that nearly one individual in every ten carries the fons et origo mali in his person, what scope is there for preventive medicine? It is obvious that under the conditions of modern civilized society, every “bacillusträger” cannot be isolated, except in the rare instances of self-contained communities like schools and barracks. It is equally certain that in England, at any rate, we cannot have universal inoculation with immunizing serum, even if such a measure were likely to be effectual, which it is not. Nevertheless, although in the case of a malady like diphtheria with an omnipresent virus, we may not be able to eradicate the disease at its source, yet, to again quote Newsholme, it would be as foolish to abandon or neglect the prophylactic measures within our reach as it would for a City Council to dismiss its fire-brigade staff on account of

⁷⁰ Newsholme. *Epidemic Diphtheria*. 1898, p. 186.

⁷¹ “Diphtheria epidemics are often inextricably mixed up with outbreaks of scarlet fever and measles.” Parkes, *Hygiene and Public Health*, p. 437. In this connection it is interesting to recall von Ranke’s observation (*Münch. Med. Woch.*, 20 October, 1896, p. 1005) that in Munich more than half (53·7 per cent.) of all cases of scarlet fever admitted into hospital during two years were found to be associated with the Klebs-Loeffler bacillus. Beggs (Report of Statistical Committee, Metropolitan Asylums Board, 1895, p. 50) found that out of 140 cases of scarlet fever admitted into the North-Eastern Hospital no less than 36·4 per cent. presented diphtheria bacilli on cultivation. A study of the Reports of the Superintendents of the Metropolitan Asylums Board shows that concurrent scarlatina and diphtheria, and especially post-scarlatinal diphtheria, are far commoner than has been generally supposed.

imperfections in the fire-extinguishing apparatus, or because the force is unable to prevent occasional big conflagrations.

SUMMARY.

Diphtheria is an infectious disease caused by the Klebs-Loeffler bacillus and *its variants*. In the latter category are included all the so-called "non-pathogenic" forms, such as the "pseudo-diphtheria bacillus" of Loeffler, Hofmann, and other authors. The bacillus, though the immediate cause, the *causa causans*, is only one factor in the determination of actual illness. Both for the production of the malady in the individual and especially for its propagation in epidemic form is required the concurrence or conjunctions of several factors; and it is these secondary influences which decide why and where and when an organism, which may have remained latent in the throat for months or years, should suddenly spring into activity and cause its host a mortal disease. Some of the influences—climatic, seasonal, etc.—act over wide areas and affect the origin, course, and distribution of epidemics. These are beyond our control, perhaps even beyond our ken. Others, such as symbiotic microbic association,⁷² affect only individual cases and are accidental and unavoidable. In other words, epidemic prevalence of diphtheria is largely independent of the existence of the diphtheria organism, and is the result of some force or forces, described by the older writers under the title "genius epidemicus," a term which for want of a better we may again adopt provisionally.

⁷² Roux and Yersin (loc. cit. p. 422) were the first to show that it was the presence of associated microbes, especially the Streptococcus, that gave to many cases of diphtheria their grave character. They demonstrated that an otherwise inoffensive diphtheria bacillus injected along with an otherwise harmless streptococcus could cause a fatal issue, the microbes mutually reinforcing each other's virulence. More recently Stoecklin (Archiv. de Méd. expér., January, 1898, No. 1, p. 1-41) has shown that a similar relation exists between the diphtheria bacillus and the common yeast (*Saccharomyces albicans*), which is not infrequently found vegetating in both healthy and diseased throats. In association with the yeast, the diphtheria organism can kill in doses which would otherwise be harmless. On the ætiological and clinical importance of the polymicrobic infections in diphtheria, vide *Hilbert*, Deutsch. Archiv. für Klin. Med. Bd. lix., 1897, p. 248-282; *Funck*, Beitschr. f. Hyg., 1894, Bd. xviii, p. 465; *Bernheim*, ibid. Bd. xviii., 1894, p. 529; *Reiche*, Centralbl. f. innere Med., 1895, No. 3, p. 65; *Dahmer*, Baumgarten's Arbeiten aus dem Gebiete der path. Anat. und Bakt., 1896, Pd. ii., Heft 2, p. 262.

APPENDIX OF CASES.

No.	Clinical Nature of Case and Termination.	Morphological Variety of Diphtheria Bacillus Present.	Virulence.	Toxicity.
1	Average severity, but severe local manifestations. Recovery	Long	6 mgm.	0.2 cc.
2	Very severe local, but mild constitutional symptoms. Recovery	Short	8 mgm.	0.1 cc.
3	Severe local and constitutional symptoms, followed by paralysis. Recovery	Medium	$\frac{1}{2}$ a serum culture	0.5 cc.
4	Very severe locally and constitutionally. Died...	Short	0.25 mgm.	0.01 cc.
5	Very mild. Recovery	Short	0.01 mgm.	5 cc.
6	Of average severity locally, mild constitutionally. Recovery.	Medium	5 mgm.	No toxin formation
7	Mild faucial and constitutional attack. Recovery	Long	Whole serum culture	10 cc. would not kill
8	Ditto. Recovery	Long	3 mgm.	0.5 cc.
9	Concurrent scarlatina and diphtheria. Mild. Recovery	Medium	3 mgm.	1 cc.
10	Of average severity, both locally and constitutionally. Recovery	Long	0.1 mgm.	No toxin formation
11	Very severe local and constitutional symptoms. Died	Short	2 mgm.	10 cc. would not kill
12	Very severe faucial, nasal and laryngeal diphtheria. Died	Short	20 mgm.	5 cc.
13	Very severe laryngeal attack. Died	Long	3 mgm.	0.1 cc.
14	Severe locally and constitutionally. Died	Long	0.5 mgm.	2 cc.
15	Of average severity, locally and constitutionally. Recovery	Long	0.5 mgm.	0.5 cc.
16	Mild faucial attack. Constitutional symptoms insignificant. Recovery	Long	0.5 mgm.	0.1 cc.

APPENDIX OF CASES—continued.

No.	Clinical Nature of Case and Termination.	Morphological Variety of Diphtheria Bacillus Present.	Virulence.	Toxicity.
17	Severe local manifestations, constitutionally, of average severity. Recovery	Long	1 mgm.	0.5 cc.
18	Moderately severe local and constitutional attack. Recovery	Long	3 mgm.	.5 cc.
19	Mild local and constitutional symptoms. Recovery	Medium	Whole serum culture	0.05 cc.
20	Mild attack. Rapid recovery	Long	8 mgm.	0.1 cc.
21	Severe faucial and laryngeal attack. Recovery...	Long	3 mgm.	0.2 cc.
22	Of moderate severity, both locally and constitutionally. Two relapses. Recovery	Short	0.5 mgm.	0.2 cc.
23	Mild faucial diphtheria, with few constitutional manifestations, but followed by paralysis. Recovery	Short	Totally non-virulent (three separate cultivations were examined)	0.5 cc.
24	Moderate local and constitutional symptoms. Recovery	Long	0.5 mgm.	0.1 cc.
25	Severe laryngeal diphtheria. Died	Long	1/4 a serum culture	0.2 cc.
26	Slight local affection and very mild constitutional symptoms. Recovery	Long	0.25 mgm.	0.04 cc.
27	Of average severity. Recovery	Short	2 mgm.	0.05 cc.
28	Very mild local and constitutional symptoms. Recovery	Long	0.1 mgm.	0.2 cc.
29	Of average severity. Recovery	Long	0.5 mgm.	1 cc.
30	Very mild attack locally and constitutionally. Recovery	Medium	3 mgm.	0.5 cc.
31	Severe local and constitutional symptoms. Intense toxæmia. Paralysis. Recovery	Short	0.05 mgm.	0.2 cc.

APPENDIX OF CASES—continued.

No.	Clinical Nature of Case and Termination.	Morphological Variety of Diphtheria Bacillus Present.	Virulence.	Toxicity.
32	Concurrent scarlatina and diphtheria, of average severity. Recovery	Short ...	Non-virulent	2 cc.
33	Average severity, both locally and constitutionally. Recovery	Medium ...	0.5 mgm. ...	0.1 cc.
34	Severe local symptoms, but very mild constitutionally. Recovery	Long ...	10 mgm. ...	0.2 cc.
35	Severe toxæmia, mild locally. Died	Medium ...	5 mgm. ...	0.1 cc.
36	Locally very severe with sloughing of tonsils. Constitutionally of average severity. Recovery	Short ...	2 mgm. ...	No toxin formation
37	Of average severity. Death from syncope during convalescence	Long ...	3 mgm. ...	0.1 cc.
38	Mild locally and constitutionally. Recovery	Medium ...	0.5 mgm. ...	0.05 cc.
39	Moderately severe local lesions, but mild constitutionally. Recovery	Mixed, long, medium and short	0.01 mgm. ...	0.1 cc.
40	Severe laryngeal diphtheria. Died	Medium ...	2 mgm. ...	0.1 cc.
41	Mild attack. Recovery	Medium ...	3 mgm. ...	0.2 cc.
42	Of average severity, but followed by wide-spread paralysis. Recovery	Long ...	Whole serum culture	0.5 cc.
43	Mild locally and constitutionally. Recovery	Long ...	1 mgm. ...	0.1 cc.
44	Ditto. Recovery	Short ...	5 mgm. ...	0.1 cc.
45	Severe local and constitutional symptoms. Recovery	Long ...	5 mgm. ...	0.2 cc.
46	Post-scarlatinal diphtheria. Mild nasal and faucial attack	Indistinguishable from Hofmann's bacillus morphologically and culturally	20 mgm. ...	0.5 cc.

APPENDIX OF CASES—continued.

No.	Clinical Nature of Case and Termination.	Morphological Variety of Diphtheria Bacillus Present.	Virulence.	Toxicity.
47	Moderately severe attack. Recovery	Long	3 mgm.	0.2 cc.
48	"Putrid" diphtheria. Very severe. Died	Long	25 mgm.	0.5 cc.
49	Of moderate severity. Recovery	Long and medium	5 mgm.	0.1 cc.
50	Post-scarlatinal diphtheria. Very mild both locally and constitutionally. Recovery	Hofmann	Non-virulent	No toxin formation
51	Very severe case, both locally and constitutionally. Early paralysis. Died	Long	Totally non-virulent	0.25 cc.
52	Very severe local and general symptoms. Recovery	Long	2 mgm.	0.25 cc.
53	Mild case. Recovery	Long	Whole serum culture	0.2 cc.
54	Moderately severe locally and constitutionally. Recovery	Short	4 mgm.	0.1 cc.
55	Mild post-scarlatinal diphtheria. Recovery	Hofmann	Non-virulent	0.5 cc.
56	Very severe laryngeal diphtheria. Died	Long	† a serum culture	5 cc.
57	"Putrid" diphtheria. Very severe. Died	Long and short	1 mgm.	0.2 cc.
58	Mild post-scarlatinal diphtheria. Recovery	Hofmann	Non-virulent	No toxin formation
59	Extensive membrane formation. Died 24 hours after admission	Hofmann	Non-virulent	No toxin formation
60	Post-scarlatinal diphtheria. Mild. Recovery	Mixed, long & short	10 mgm.	0.2 cc.
61	Mild locally and constitutionally. Recovery	Medium	5 mgm.	0.5 cc.
62	Post-scarlatinal diphtheria, of average severity. Recovery	Long	0.1 mgm.	2 cc.
63	Mild post-scarlatinal nasal diphtheria. No constitutional symptoms. Recovery	Hofmann	Non-virulent	No toxin formation
64	Very slight local manifestations, but severe constitutional symptoms. Paralysis. Died	Long	5 mgm.	0.5 cc.

APPENDIX OF CASES—continued.

No.	Clinical Nature of Case and Termination.	Morphological Variety of Diphtheria Bacillus Present.	Virulence.	Toxicity.
65	Very severe local manifestations with extensive false membranes. Constitutional reaction mild. Recovery	Hofmann ...	Non-virulent	No toxin formation
66	Of average severity. Recovery	Short	3 mgn.	0.1 cc.
67	Ditto. Recovery	Short	3 mgn.	0.2 cc.
68	Extensive local lesion, but mild constitutionally. Recovery	Medium	1 mgn.	1 cc.
69	Laryngeal case of average severity. Recovery	Long	1/2 a serum culture	0.1 cc.
70	Mild post-scarlatinal diphtheria. Recovery	Hofmann	Non-virulent	No toxin formation
71	Mild locally and constitutionally. Recovery	Long and short	1/2 a serum culture	0.2 cc.
72	Moderately severe attack. Recovery	Short	Whole serum culture	0.1 cc.
73	Extremely mild locally and constitutionally. Recovery	Short	.25 mgn.	0.1 cc.
74	Moderately severe case, both locally and constitutionally. Recovery	Medium	4 mgn.	2 cc.
75	Of average severity. Recovery	Medium	6 mgn.	0.1 cc.
76	Ditto. Recovery	Long	2 mgn.	3 cc.
77	Severe local and constitutional symptoms. Much sloughing. Recovery	Medium	4 mgn.	0.2 cc.
78	Moderately severe nasal diphtheria. Recovery	Hofmann	Non-virulent	No toxin formation
79	Mild nasal diphtheria. Recovery	Hofmann	Non-virulent	No toxin formation
80	Moderately severe local and constitutional symptoms. Recovery	Long	Whole serum culture	0.1 cc.
81	Very mild faucial case. Recovery	Hofmann	Non-virulent	No toxin formation
82	Mild local and constitutional attack. Recovery	Long	3 mgn.	1 cc.
83	Ditto. Recovery	Long	5 mgn.	0.04 cc.

APPENDIX OF CASES—continued.

No.	Clinical Nature of Case and Termination.	Morphological Variety of Diphtheria Bacillus Present.	Virulence.	Toxicity.
84	Severe local and constitutional symptoms. Recovery	Medium	10 mgm. ...	0.5 cc.
85	Mild post-scarlatinal diphtheria. Recovery	Long and medium	Whole serum culture	0.1 cc.
86	Ditto. Recovery	Long	2 mgm. ...	0.5 cc.
87	Severe ditto. Recovery	Short .. ..	.1 mgm. ...	0.5 cc.
88	Mild ditto. Recovery	Long	Non-virulent	No toxin formation
89	Severe local and constitutional symptoms. Recovery	Long .. ..	.5 mgm. ...	0.1 cc.
90	Concurrent scarlatina and diphtheria of moderate severity	Short .. ..	.1 mgm. ...	5 cc.
91	Severe local and constitutional symptoms. Recovery	Short and medium	3 mgm. ...	5 cc.
92	Severe laryngeal diphtheria. Died	Medium	5 mgm. ...	0.2 cc.
93	Mild locally and constitutionally. Recovery	Medium and short	Non-virulent	0.05 cc.
94	Mild post-scarlatinal diphtheria. Recovery	Hofmann	Non-virulent	No toxin formation
95	Moderately severe case followed by paralysis. Recovery	Medium	2 mgm. ...	1 cc.
96	Post-scarlatinal diphtheria. Mild. Recovery	Medium	3 mgm. ...	0.5 cc.
97	Of average severity. Recovery	Long	5 mgm. ...	0.1 cc.
98	Very grave case, with subsequent severe paralysis. Recovery	Medium	1 mgm. ...	0.5 cc.
99	Severe laryngeal diphtheria. Died	Long	Non-virulent	No toxin formation
100	Average severity, both locally and constitutionally. Recovery	Short .. ..	.1 mgm. ...	0.1 cc.
101	Very severe constitutional symptoms. Syncope. Died	Short	1/2 serum culture	0.5 cc.
102	Slight local lesion with severe toxæmia. Recovery	Long	10 mgm. ...	0.2 cc.

APPENDIX OF CASES—continued.

No.	Clinical Nature of Case and Termination.	Morphological Variety of Diphtheria Bacillus Present.	Virulence.	Toxicity.
103	Constitutional symptoms of great gravity. Recovery	Medium ...	5 mgm. ...	No toxin formation
104	Very mild faucial diphtheria. Recovery	Hofmann ...	Non-virulent	No toxin formation
105	"Putrid" diphtheria. Severe toxæmia. Died...	Short ...	3 mgm. ...	2 cc.
106	Extensive local lesion and grave constitutional symptoms. Recovery	Short ...	20 mgm. ...	0.02 cc.
107	Mild faucial diphtheria. No sequelæ. Recovery	Hofmann ...	Non-virulent	No toxin formation
108	Of average severity. Recovery ...	Medium ...	Non-virulent	0.05 cc.
109	Very mild faucial inflammation. Practically no constitutional symptoms. Recovery	Long ...	.25 mgm. ...	0.5 cc.
110	Moderately severe both locally and constitutionally. Recovery	Short ...	3 mgm. ...	5 cc.
111	Mild local but severe general symptoms. Recovery	Long ...	3 mgm. ...	1 cc.
112	Very severe case. Grave toxæmia and extensive local sloughing. Recovery	Medium ..	Whole serum culture	0.1 cc.
113	Of average severity. Recovery ...	Long ...	Whole serum culture	1 cc.
114	Mild case of stomatitis. Recovery	Hofmann ...	Non-virulent ...	No toxin

MEDITERRANEAN FEVER.

BY GERALD SICHEL, F.R.C.S., SURGEON, R.N.

(COMMUNICATED BY THE EDITORS.)

THE name "Mediterranean" is used here as it is the one officially appointed to be used in returns; I do not think it a good one for two reasons: viz.—

(1). Many authorities believe that the disease is much more widely distributed, *e.g.* in India, China, and even America. I believe that I myself have met with it at Zanzibar.

(2). Many of the fevers met with in the Mediterranean differ from the one now under consideration, *i.e.* "Venetian" Fever and "Greek" Fever. In Venice, besides malaria, another fever is met with—it averages twelve to eighteen days only in duration, according to Dr. Van Someren, who was kind enough to communicate with me on the subject, and is curable by rest, dieting, antipyretics, and purgatives.¹

I have tried the treatment he recommends and found it fail entirely in all my cases. It therefore differs from Mediterranean Fever, inasmuch as its duration is infinitely shorter and it is amenable to treatment.

Among other names Mediterranean Fever is also called Malta Fever, Rock Fever (Gibraltar), Neapolitan Fever—according to the locality it occurs in. Febris Suderalis, Intermittic Typhoid,

¹ Dr. Kepler, Dr. Van Someren's partner, has had great experience in Venetian Fever.

and Gastric Remittent Fever—from particular symptoms of individual cases—and Fæco-malarial Fever from its supposed origin. These various names will give some idea of its widespread distribution in the Mediterranean, and of the indefinite nature of its symptoms. Lately the name of Undulant Fever has been suggested.

Etiology.—Many consider it essentially a filth disease; and this is probably the case, though whether it be conveyed to man by water, food, or air, has still to be discovered.

A remarkable fact to be noted is the amount of diarrhœa and colic—usually accompanied by more or less fever—which occurs in those fresh to a station (we had about thirty cases in the first month in a crew of under six hundred men). So common is this experience, that one's mind involuntarily turns to the ingesta as a possible carriage for the poison of Mediterranean Fever. Goat's milk—the milk of the poor—is universally used among all classes all over the Mediterranean, and the goat is by no means a particular feeder. An impure water-supply by itself can hardly be a very important cause, otherwise this fever would not be so prevalent in H.M. ships, where the water supply is excellent.

Dr. Hughes, A.M.S., in his book on “Mediterranean Fever,” brings forward very strong evidence pointing to sewer gas being the immediate cause in Malta, where insanitary conditions are the rule—as indeed they are in almost all Mediterranean towns.

Malta itself is practically a soft sandstone rock, which must for years past have acted as a veritable sponge in soaking up sewage matter; vegetation is chiefly remarkable for its scarcity, so that but little of the filth has been used up as manure.

This fever occurs chiefly in the dry summer, and possibly the germs exist in the dust, which of course must ultimately come from the sandstone.

Similar conditions are common to many of the Spanish ports, Naples and other Mediterranean towns, except in the eastern Adriatic Coast, where vegetation is much more abundant.

Some think that the disease can be directly conveyed to other persons by emanations from the sick.

During the six summer months, April–September, 1897, we had thirty-one cases on board H.M.S. *Gibraltar*: the average humidity (assuming saturation to be 100°) each month was as follows² :—

				Humidity.	Cases admitted to Sick List.	
April	...	...	...	78%	...	—
May	...	...	...	82%	...	3
June	...	...	...	83%	...	8
July	...	...	...	89%	...	11
August	...	...	...	79%	...	4
September	...	...	...	74%	...	5

It will be seen that most of the cases began in June and July, when the humidity was greatest: and in the individual cases there seems to be a certain relation between a high humidity of the atmosphere and the onset of the disease.

Age does not appear to exert any particular influence, neither does sex; of the twenty-eight cases mentioned above, the youngest was seventeen, the oldest thirty-one, but these were all among sailors or others in the ship.

Mortality is very small, only two per cent., according to Bruce. We had one case among the twenty-eight. The amount of invaliding from the station is, however, high.

Symptoms.—There are three well marked varieties :—

(1). Those cases in which gastro-intestinal disturbance is the marked symptom at the onset. Thus :—

B. S., æt. 18, came on the sick-list with vomiting, diarrhœa, and occasional attacks of colic. Temperature 99·4. The gastro-intestinal symptoms soon subsided and the case continued as one of persistent slight pyrexia which resisted all treatment, and for which he was eventually invalided. He was on the sick-list seventy-one days before going to hospital, and in hospital nearly two months before being sent home.

² Only the most severe cases are referred to in the table; we had other cases of fever which were probably mild forms of Mediterranean Fever: if these be included the figures would be as follows :—May, 3; June, 15; July, 17; August, 6; September, 7; we also had one case in October, four in November (1 a relapse) and a relapse-case in December. In July also 24 more or less severe cases of Colic and Diarrhœa occurred.

(2). Those with rheumatic or neuralgic pains :—

J. C., æt. 23, was on the sick-list from 20th July to 30th August. Came on the list with temperature 102·3 and severe pain in left hip; no objective signs. Later, the pain disappeared, but he gradually emaciated and grew anæmic. He had occasional slight colicky pains, and also pain and tenderness over the third left rib, about two inches from the sternum. He was eventually invalided, his only other symptom being a persistently varying temperature.

(3). Those which have no definite symptoms except a persistently high temperature.

CHART A.

P. C., æt. 31, came on the sick-list feeling “ heavy ” and feverish. Temperature 102·4. No albumen in urine, and no definite pain or complaint. He came sick on the 20th of June, was sent to hospital on 4th July, and invalided home on 9th September.

The onset may be sudden but is more often gradual; if sudden, there may be rigors—four cases had them—or it occurs with colic or diarrhoea or vomiting—if gradual, with headache and general febrile pains; or, again, it may appear with some rheumatic pains in the hip or about the sacro-iliac joints, accompanied by tenderness—very often so localised as to suggest the presence of an abscess in the bone, but no redness or swelling :—

E. G., æt. 20, came on the sick-list on 8th July with extreme pain and tenderness over the left trochanter major; was on the list from 29th June to 5th July, when hip disease was suspected, but he appeared to completely recover; his temperature was raised (99°–100° in the mornings, 101°–102° in the evenings) and there was marked tenderness over one spot on the trochanter major, about the size of a sixpence. He was quite crippled, and therefore sent to hospital on 19th July.

Three cases began with pain, tenderness, and swelling of the testicle :—

W. L., æt. 17, had been in hospital in March for pneumonia; came on sick-list on 27th May with neuralgia of right testis and a hard lump in globus major; no varicocele, no

fluid, no gonorrhœa or history of gonorrhœa; cord thickened but smooth. "Fulminating" tuberculous epididymitis was thought of, as his mother had died from phthisis, but by the 1st of June this lump had disappeared. On 31st of May he had a sharp attack of sciatica in the right side, which lasted a few days; since then his temperature had gradually risen and it now persisted at 101° – 103° . On 11th June he was sent to hospital on account of his temperature, although he had no pain or other complaint. No albumen in the urine; no optic neuritis.

A. A., æt. 30, came on sick-list, 9th September, with epididymo-orchitis of right side. Temperature 105° . No gonorrhœa; he "was not sure if he hadn't knocked it some days before." The swelling took nearly a month to subside; he was invalided on 26th November, as although he had no pain or other complaint, his temperature remained persistently high; his heart and lungs were normal, and there was no albumen in the urine. A few days before he was invalided he suffered from profuse epistaxis for two days.

If headache exists it is usually frontal and is often accompanied by pain in the eyeballs. There appears to be no relation between the taking of food and the vomiting, colic or diarrhœa if present.

Constipation is by most authors given as a very prominent symptom. It was noteworthy in six cases, though by no means difficult to overcome; in fact, I think it was no more than one might expect in any ordinary febrile case.

If diarrhœa³ exists at the onset it never persists long, neither as a rule do the colic and vomiting. The early rheumatic cases often presented no objective signs, but tenderness is usually present, generally over some bony point, as the trochanter; or if in a muscular part, as the shoulder, the soft parts are found to be tender when seized between the finger and thumb:—

T. J. M., æt. 20, admitted to the sick-list, 22nd June, with headache, pain in back and sides, temperature 100.8° .

³ The motions are often light coloured from a milk diet; I remember testing the reaction of one case, which at first was like a typhoid stool, and finding it alkaline. Dr. Zamunit, of the Health Department, Malta, tells me that he has often found the stools alkaline.

He has remained feverish almost ever since. He has had rheumatoid pains in right shoulder and arm accompanied by muscular tenderness; and latterly pain and tenderness on pressure over the fifth left costal cartilage at its junction with the sternum; no enlargement of the spleen was made out. On 21st July his right ear began discharging; the membrana tympani appeared in great part to be replaced by granulation tissue—he had had otorrhœa eighteen months before on this side. He was invalided on 30th July.

This last case also has two other interesting points, the pain over the fifth left rib and the condition of the spleen.

Pleurodynia is common, and is often referred to intercostal neuralgia. In all our cases the tender point was *on*, not between the ribs or cartilages. It was only complained of on the left side; once on the second, once on the third, and in the above case on the fifth rib.

Hughes says, “the spleen can nearly always be made out by percussion and palpation below the margin of the ribs, and occasionally is considerably enlarged especially in malignant cases;” later, “in long attacks it often shrinks again.” This has not been so with our cases. I have percussed out many spleens and only found the splenic dulness to reach to the costal margin twice; one case, however, which was probably Mediterranean Fever, but which was only under my observation for one day before going to hospital, was found after death, which occurred shortly afterwards, to have a much enlarged and softened spleen.⁴

Whatever form the fever takes at its commencement, if the attack does not abort, it usually settles down into a case which is remarkable for its chronicity, for its high temperature which resists all treatment, and for its anæmia and gradual emaciation, often accompanied by troublesome rheumatic symptoms.

The clinical picture of a chronic case is much as follows:—The patient's complexion is “muddy,” and his expression jaded; he is extremely emaciated but says his appetite is fairly good;

⁴ Dr. Zamunit says that he has only been able to make out the splenic enlargement by percussion, but not by palpation, as his experience is that the spleen is seldom, if ever, enlarged beyond the costal margin.

he may or may not be suffering from rheumatism or neuralgia, but expresses himself as feeling "well in himself." His temperature is taken and found to be 100° or 102° , or even more. I remember one convalescent at Haslar being discovered with a temperature of 105° ; he was allowed to be up at the time and was most indignant at being sent back to bed.

The temperature of a case that is under observation long enough, is in many cases, I venture to think, *the* characteristic of the disease,; it runs in waves, hence the latest name suggested for this fever, Undulant Fever⁵; that is to say, it is characteristic when found, but it is by no means always present.

CHART B.

This man, A. E., æt. 18, came on the sick-list on 21st June, with frontal headache; he grew anæmic and wasted. Later on he suffered from somewhat severe pains about the left hip and sacro-iliac joints. He was discharged to Malta Hospital on 28th July.

There is nothing more to be said about this case. The patient said that he had had some shivering just before he "came on sick." On 11th July the rheumatic symptoms began, and on 22nd they were bad enough for him to be confined to his hammock.

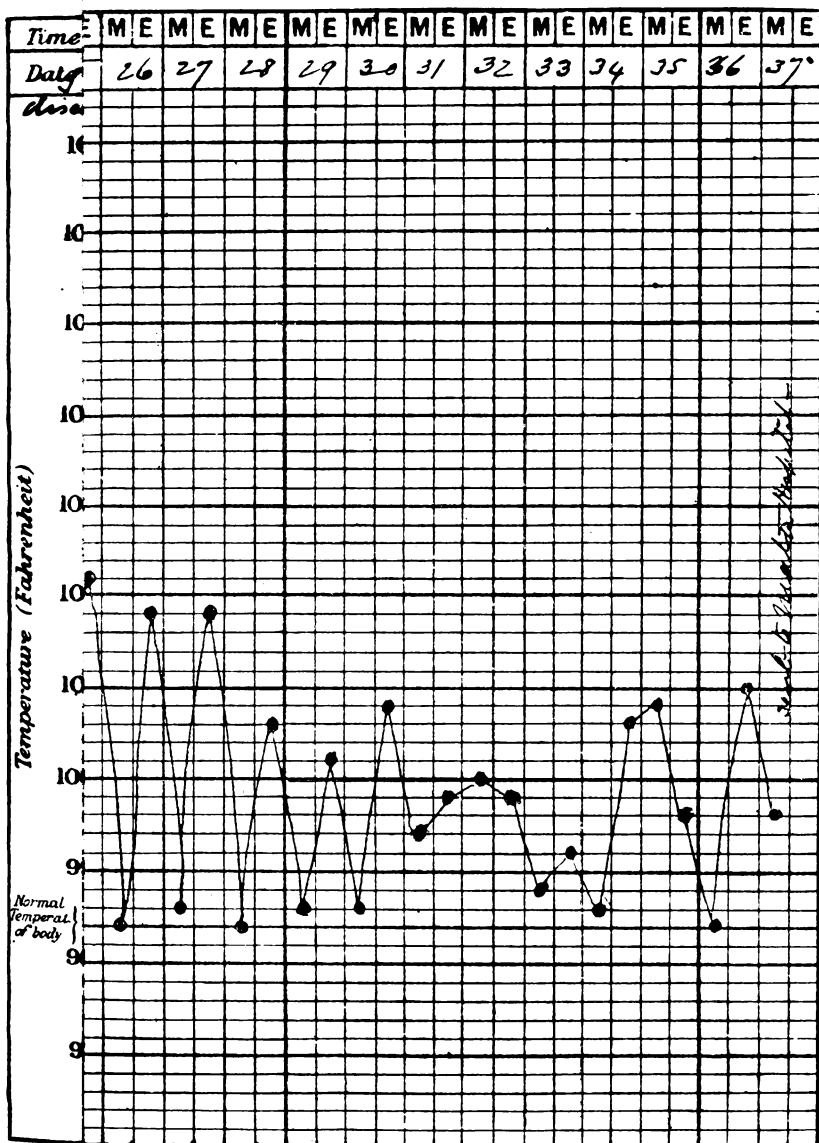
It will be seen by looking at the chart that there are roughly three waves, though the third was only just starting when he was sent to the hospital. In connection with this kind of fever it is interesting to note that Dr. Hughes points out that unless a patient's tongue gets clean at the same time, a fall of temperature to normal, even if it persists for some time, must be looked on with suspicion, since it is generally only temporary.

The above case was invalided home on 13th August.

CHART C.

E. H., æt. 26, was on the sick-list for a slight "cold" 7th to 10th May (catarrhal symptoms: temperature, morning 99° , evening 100.2° first day; morning 99.2° , evening 99° the next, and then normal). On 15th he again came down to the sick-bay with temperature 102.4° , complaining of "hot sweats,"

⁵ This is the name suggested by Surg.-Capt. Hughes in his book on "Mediterranean Fever."



slight tremor, no rigors, no vomiting, no enlarged spleen; heart, lungs and abdomen normal; no albumen in urine. The onset was sudden; later he had some slight pains in his knees. On 11th June he was sent to Gibraltar hospital; he expressed himself as feeling well, but was much wasted, with a clay-coloured complexion. He was invalided home on 17th June.

Occasionally grave cases of hyperpyrexia occur, in which, as usual, cold applications, either sponging or a wet pack, form the only treatment which does any good.

CHART D.

The above chart refers to a case which occurred unusually late in the year:—

F. S., æt. 22, "came on sick" 3rd November with fever and general febrile symptoms. He had been troubled with constipation. While on the sick-list he fell into a very low "typhoid state," with sordes on teeth and lips, dry furred tongue, flushed cheeks and sunken eyes. He suffered considerable pain in the left side, and had occasionally agueish attacks. A rub could be heard at the left base behind, where also movement, T.V.F. and resonance were a little deficient; no cough; respiration hurried (38); pulse fairly good; no albumen in urine; no enlargement of spleen. During the hyperpyrexia the skin was hot and dry until the latter part, when he sweated freely and his temperature fell. He was sent to hospital (Malta) on 22nd November, where he had another attack of hyperpyrexia, but eventually recovered sufficiently to be invalided home on 13th December. The physical signs in his left lung were never very marked, varied slightly from day to day and only lasted a few days altogether. After he left the ship nothing definite could ever be made out in his chest. This is a good example of what may be called the virulent or malignant type of Mediterranean Fever.

In any case of Mediterranean Fever it is by no means unusual for a dry cough, without expectoration or physical signs, to be complained of, and pleurisy and bronchitis may complicate matters. Surgeon Knightley, H.M.S. *Camperdown*, tells me that

in some of his cases he has found some slight dulness and loss of breath-sounds behind, which he takes to mean a slight passive effusion.

Occasionally, but rarely, the fever may end by crisis early in its course ; I have heard of two such cases, the following is one :—

CHART E.

D. S., æt. 30, put on the sick-list 10th June, 1896. Temperature 103° , great headache, pains in limbs, pains in epigastrium and tenderness over liver which was much congested, the lower edge reaching one inch below the normal. The tongue soon got black and dry. The patient was extremely drowsy and rather stupid. Two days later his pulse got very feeble, and he was unable to keep down any food, vomiting everything he swallowed. Suddenly, at the end of the first week his temperature dropped from 104° to 100° , and later was sub-normal. He made an uninterrupted recovery. He was given no antipyretic treatment.

The above case was one of Surgeon Knightley's⁶; he kindly placed his notes at my disposal. Another point is worthy of notice here, besides the temperature, *i.e.* the enlargement of liver which is sometimes met with.

The temperature of Mediterranean Fever it will be noticed in the charts given, is almost invariably higher in the evening than in the morning; save in exceptional cases the temperature was always taken with us at 8 a.m., 6 p.m., and 9 p.m. The 6 p.m. temperature was nearly invariably higher than the 9 p.m. one, even where no antipyretics were given.

It is probable that the heart is never affected more than in any other fever. In one of my cases, however, a triple apex beat was to be heard for some time; it eventually disappeared, but at the time, and for some time later, præcordial distress and dyspnœa were complained of; this was in a very severe case in a man, æt. 29, who eventually recovered after being ill for nearly two months, after which he was invalided home.

Albuminuria, when present, appears to be directly due to the pyrexia; it is not common, and is frequently absent even in

⁶ Surgeon Knightley, R. N., H.M.S. *Camperdown*.

cases of grave hyperpyrexia. Nervous symptoms include tremors, subsultus, tenderness, jactitations, delirium, sleeplessness, and sciatica, besides other neuralgic pains.

In cases of severe pain in a limb atrophy of the muscles may occur to some considerable extent.

T. B., æt. 23, had Mediterranean Fever with very severe and prolonged pain in the left sacro-iliac joint. After he had been on the sick-list eleven days, his left thigh was found to measure a good half-inch less in circumference than the right; after being ill for forty-eight days he returned to duty. About a month later the thighs were again measured and found to be the same.

Sweating is often profuse, and is so commonly met with that it gives origin to one of the names of the fever; sweating, however, is common enough in healthy persons also, who spend the summer in the Mediterranean.

Sudamina may occur, but I have never seen any other rash. Dr. Knightley, however, had a case which he considered Mediterranean Fever, in which a purpuric rash occurred over the lower half of the right leg, the ankle on the same side being painful and swollen.

Complications.—One case had otorrhœa; he had previously suffered from a discharge from the same ear some eighteen months before. His case is given above. Hyperpyrexia also has been mentioned. Paralysis, or at any rate paresis may occur. I have heard of one case in which, late in the course of the fever, facial paralysis occurred. I am unable, however, to give any particulars. The hair may fall out during convalescence. One man had herpes on the lips.

B. B., æt. 22. Previous history: had had pneumonia and secondary syphilis. Present disease began twenty-nine days ago, with febrile pains, constipation, frontal headache, and furred tongue. Temperature 100°. On the third day he had herpes on both sides of each lip. By the twenty-first day he had developed a fair-sized bubo in the left groin. No sore on the penis or other cause discovered. Temperature came down in a day or two from the onset, from 100°–101° to normal,

only almost at once to be again raised to 100° or a little higher. It again gradually came down to normal in the mornings, and was raised about a degree in the evenings. These notes were made on 27th September, when he left the ship for hospital.

The bubo in this case is an example of the occasional enlargement of lymphatic glands sometimes met with in this disease.

Diagnosis.—Until lately the diagnosis of many cases from typhoid was extremely difficult, both diseases often being extremely indefinite and obscure; and, moreover, the motions in Mediterranean Fever often closely resemble those of typhoid both in appearance and in being alkaline. Latterly, however, Widal's serum method has been adopted and with marked success; often the reaction is so marked that it can be distinguished with the naked eye.⁷

Bacteriology.—Surgeon-Captain Bruce, A.M.S., discovered the micrococcus of Mediterranean Fever. It is very small, only measuring $\cdot 33\mu$; it is discovered in the spleen after death. Quite lately an antitoxine has been prepared, and is now being used at Netley.

Treatment.—There is no known specific for this formidable disease, which is the great cause of invaliding from the station. Quinine is absolutely useless; salol does no appreciable good; carbolic acid, salicylates, arsenic, and many other drugs have been repeatedly tried and failed. It is to be sincerely hoped that a cure has been discovered in the antitoxine above mentioned, otherwise we shall have in future to look entirely to prophylaxis. At present, in these cases only the symptoms can be treated on ordinary principles. Take Malta as an example; it is, as a matter of fact, a favourable one compared with many Mediterranean ports.

1. The drainage.—The plan at present under consideration by the authorities should do much, but even at present where the

⁷ A case is often settled in three or four minutes in the Public Health office at Malta; sometimes, however, several days were needed before the reaction occurs; about which day or week the serum gives a diagnostic result in the affirmative, is a point which is now being worked at.

new system is at work most abominable stinks make themselves only too evident.

2. It has been suggested to plant trees all over the island ; and this would act in more than one way : it would use up much of the organic filth from the soil, and it would also tend to attract rain from the damp sirocco winds, and thus make the climate far more bearable in the summer.

3. Notification in this disease should be enforced as strictly as possible ; and, finally, as a result of this last measure—

4. A house to house visitation should be made by properly qualified sanitary inspectors, as has been done in parts of New York in the attempt to lessen the amount of tubercle.

All these measures would, of course, be expensive, but in the long run it will be the cheapest course ; and considering how rapidly the island population is increasing, and the importance of Malta as a naval and military station, it would be well if the matter were taken in hand immediately. In ships, the frequent soaking of the wooden decks in “scrubbing decks” is a possible factor, especially if harbour water be used ; it would be much better if they could be beeswaxed and polished, or were painted ; at any rate harbour water ought never to be used for this purpose ; and further, to my mind, it is extremely doubtful if it is wise to allow men to bathe in polluted water like that in Malta harbour.

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1. Davidson's “Hygiene and Diseases of Tropical Countries”
(Bruce's Article on Malta Fever).
2. Hughes' “Undulant or Mediterranean Fever.”

THE SURGICAL TREATMENT OF (UNPERFORATED) GASTRIC ULCER, WITH AN ACCOUNT OF THREE CASES IN WHICH OPERATIONS WERE PERFORMED.

By HASTINGS GILFORD, F.R.C.S.

(COMMUNICATED BY THE EDITORS.)

So much attention has of late been given to the surgical treatment of gastric ulcer after perforation has taken place, that this method of treatment has speedily become established among orthodox surgical measures. Less than ten years ago, perforation of an ulcer of the stomach was treated medically, without hope of success; now that it is dealt with surgically the results are so encouraging that we may confidently look to the saving of more than 50 per cent. as the result of future operations. But, besides the reduction of the death-rate, another result has been attained. We have arrived at a position from which we are enabled to ask whether the time has not come for another advance to be made in the same direction, and for ulcers to be operated upon before they perforate. Is it not possible, by exercising judicious selection, to deal with the more dangerous cases by surgical means, while the less dangerous are still left to the physician?

Hæmorrhage, again, is, in some cases, no less appalling than perforation. It is one of the axioms of surgery that in all cases of bleeding, in which it is possible to reach the source of hæmorrhage, the ruptured vessel should be twisted or tied. Why, then, are so many cases of relapsing hæmatemesis allowed to die without some attempt being made to save them by operation? Recent experience of hæmorrhage of a similar relapsing character in ectopic gestation, shows, that however extreme the bleeding may be, so long as life exists, there is a possibility of saving the patient. Is it possible that in the treatment of gastric hæmorrhage we are influenced rather by ideas carried on from pre-antiseptic periods than by principles founded on present day knowledge?

There are many facts which give point to these questions:—

1. In the first place, experience has proved that there is nothing in the operation of suturing a perforated ulcer to cause us to look upon it with any great dread. The causes of death are almost invariably due, not to the opening of the abdomen, but to the direct consequences of perforation.

2. On the one hand, the death-rate of cases of gastric ulcer treated medically is high. It has been variously estimated to be from 8 to 30 per cent. According to Brinton,¹ whose book is still the best authority on the subject, the death-rate from perforation, hæmorrhage, and exhaustion alone, is about 18 per cent. But in giving these figures he points out that indirect causes of death such as phthisis ought also to be taken into consideration.

On the other hand, according to Drs. Weir and Foote², who wrote in 1896, the number of operations which had then been published, amounted to 78, and the mortality to 71 per cent. But they show that, when these cases are analysed, those in which the operation was done within twelve hours of perforation, had a death-rate of only 39 per cent., while of those which had been allowed to continue over twenty-four hours without surgical intervention the death-rate was 87 per cent. Now it is most improbable that these figures indicate the actual number of deaths which result from the perforation of gastric ulcers followed by operation, for it is

¹ On Ulcer of the Stomach, p. 54.

² *Med. News*, New York, Vol. xviii. No. 17, p. 449.

almost certain that far more successful than unsuccessful cases are reported. I myself know of six unsuccessful cases which have not been recorded against one that was successful. But this does not affect the question of the results of prompt as compared with delayed operation, except perhaps to accentuate the advantages of the former. The lesson taught by these statistics is that the septic consequences of perforation are to be dreaded above every other circumstance, and that the object of the surgeon should be to save the patient from these consequences. They show, in fact, that the ideal time for operation, from the surgeon's point of view, is before the peritoneum has been soiled by the escape of stomach contents, or, to use an Irishism, they prove that the best time for operating upon a perforated gastric ulcer is before perforation has taken place.

3. In certain cases, a special liability to hæmorrhage and perforation may be noticed almost from the outset. This has led to the division into two forms, which have been called the dangerous and the benign, and clinical details are given, whereby one may be distinguished from the other with a fair prospect of success. Now, it is evident, if we put on one side the less dangerous of these two kinds, we shall have remaining a form of ulcer with a death-rate of considerably over 18 per cent. due to direct causes alone.

4. Another reason for anticipating perforation is one of expediency. The surgeon who has to operate upon a patient in a state of collapse does so at a distinct disadvantage. In many cases of perforation there has not been time to search for the ulcer owing to the condition of the patient. It must be for the welfare of the patient that the surgeon should choose his own time, and should be able to operate at leisure.

But this is an optimistic view of the matter. Further consideration shows that the prospects are not quite so favourable as they at first appear.

(i). In no less than sixteen cases in which an operation was resorted to for the perforation of an ulcer, no ulcer was found, and though it is true that this was sometimes due to haste, yet in others it was because of the inherent difficulties incidental to the operation itself. For it must be insisted upon that the operation

is by no means always an easy one. It may be very difficult. The search for an ulcer is sometimes very prolonged, even when perforation, inflammation, adhesions, and the escape of gastric contents, all serve as guides to the seat of the lesion. It must be expected that when an ulcer has not perforated, and none of these indications exist, the search will be even more often unsuccessful.

Inability to find an ulcer may arise from one of three causes:—

(a). The ulcer may be so situated as to be beyond the effective reach of the finger. No one who has tried to explore the cardiac end, with one finger through an opening in the stomach, can fail to appreciate how large this area may be.

(b). Ulcers which give rise to hæmorrhage are sometimes difficult to find owing to their small size. In one such instance³ no ulcer having been found after minute inspection of the interior of the stomach, the wound was closed without the source of bleeding having been discovered. Still worse, the patient died from peritonitis, and, after death, several shallow ulcers were found on the anterior and posterior walls. Some were cicatrized and all were distinguished with difficulty. The incision in this case was an inch and a half long, and was made through the pylorus. This inability to find the ulcer is referred to by Weir and Foote who emphasize its importance. They say that they have “seen at autopsy two cases in which an operation had been refused and in which death followed repeated copious hæmorrhage. In both cases the ulcer was so minute that it was difficult to find it when the whole stomach was spread out in a good light. In one of the cases its presence was positively shown only by transmitted light, which revealed a slight thrombus in the eroded vessel, situated in an otherwise bloodless stomach-wall.”⁴

(c). The presence of more than one ulcer may be another cause of the non-discovery of the seat of hæmorrhage, for the real cause may then be overlooked and attention directed to more conspicuous but less harmful ulcers. Brinton says that in 21 per cent. of all cases of gastric ulceration the ulcers are multiple.

³ Dr. Abbé, *New York Med. Journ.*, May 2nd, 1891, p. 519.

⁴ *Med. News*, New York, vol. xviii., No. 17, p. 490.

In one instance⁵ in which an ulcer was sought for and not found it was impossible to say what was the cause of the inability to find it, for after the operation the symptoms for which it was undertaken gradually disappeared. These symptoms consisted of severe pains, almost daily sickness, and frequent vomiting of blood. They occurred in a woman of twenty-five, lasted for fourteen years, and had defied many efforts at cure; yet when the stomach was opened nothing abnormal could be found, though it was thoroughly examined both with the finger and by means of the electric light.

(ii.) Hæmorrhage from the stomach is not always due to ulceration. It may be due to the rupture of varicose veins in the stomach or œsophagus, or of miliary aneurisms. Comte quotes several cases showing that the bleeding from each of these causes may be so severe as to cause death. Hæmorrhage may also be symptomatic.

(iii.) There is this difference between the procedure in a case of perforated and one of unperforated ulcer that the former is at once sewn up without being excised, whereas in the latter an opening in the healthy stomach must often be necessary in order to find it. Moreover, when it has been found a further wound has to be made in refreshing its edges or cutting it out, for I suppose no surgeon would rest satisfied with merely bringing its sides together. And, when it is remembered that the stomach is well supplied with blood-vessels and that these are often particularly large in the neighbourhood of an ulcer, serious trouble may sometimes be expected to arise from hæmorrhage.

(iv.) A difficulty which I have not seen mentioned before, but which was experienced in my first case, is persistent retching. This, as will be seen, may be so severe as to resist all treatment, and be the direct cause of death.

(v.) But to some the most pertinent reason of all for remaining content with the medical treatment of gastric ulceration is that the prognosis, in spite of all statistics to the contrary, is believed to be good. None of the physicians I have spoken of on this subject own to a death-rate of more than 5 per cent., and one of

⁵ Dr. E. H. Bradford, *Trans. Amer. Surg. Assoc.*, p. 219, 1892.

them told me that though he sees a great many cases among his out-patients and in private practice and nearly always has three or four under treatment in a hospital, he has never lost a single case. One source of fallacy has always to be thought of in estimating the value of medical statistics, and that is whether the figures refer to picked cases. Perhaps, of all statistics, hospital statistics are regarded with most suspicion, and, rightly, when they are applied to the estimation of the mortality of disease. Now, Brinton apparently obtained his figures from hospital patients only, and therefore will hardly satisfy those who insist that in order to have convincing statistics one ought to make sure that there is not too great a preponderance of very severe cases. But this cannot be said of those which are admitted into the wards of a hospital, for it is notorious that people do not usually apply for treatment as in-patients until their symptoms have reached a certain degree of severity.⁶ On the other hand, it may be argued that so far from hospital cases being unusually severe it is quite as likely that the most severe cases of all seldom find their way into the wards of a hospital. Fatal hæmorrhage and perforation do not as a rule take place in hospitals, but fall into the hands of the general practitioner, who is called in to attend them in their own homes, because they are too ill to permit of removal. There is, no doubt, much truth in this view, but in order to reconcile the discrepancy between general experience and the more exact observation upon which statistics are based, perforation and fatal hæmorrhage ought to be common in general practice. But, as a matter of fact, those general practitioners to whom I have spoken all agree that these accidents are rare events in their experience. I do not think that any doctor in general practice will admit that one out of every five of the cases of gastric ulcers under his care dies from hæmorrhage, perforation, or exhaustion.

(vi.) But what tells still more in favour of our regarding ordinary gastric ulcer as a malady which is by no means dangerous is that many cases escape recognition. It is well-known that the disease

⁶ But more recent statistics than Brinton's fully bear out his conclusions. Some of these are obtained from all classes of patients (*e.g.* Dr. Habershon's *St. Bartholomew's Hospital Reports*, 1896, p. 149).

is often latent or is confounded with those amorphous complaints, gastric catarrh and atonic dyspepsia. Though it is true that the ulcer in these cases sometimes first declares itself by fatal hæmorrhage or perforation, yet it must be conceded, I think, that these terminations must be very exceptional, and rather serve to indicate that a large number of ulcers run a mild course and heal without recognition.

But fortunately we are not called upon to decide whether the death-rate from gastric ulcer is large or small. It really matters very little to the surgeon whether it is 8 or 18 per cent. It is not so much his province to take notice of the prospects of the disease in general as to deal with each case on its own merits. It is of far more importance to him that he should be able to decide in any particular instance whether he has to deal with a grave or with only a trivial case, and if it be grave, whether surgical treatment holds out good prospects of success. A judicious summary of the cases for and against operation is perhaps best arrived at by stating under what circumstances an operation may be justifiable. It must then be left to individual opinion, bearing on each individual case, not merely to decide whether the chances of success are for or against operation, but whether a let-alone policy will almost inevitably condemn the patient to death; and not only this, but in addition, whether there is a good prospect of carrying out a successful operation. But we ought, I think, at the same time to take into consideration the fact that the life of a patient with gastric ulcer and its sequelæ is sometimes a life of confirmed painful dyspepsia, and that under these circumstances cure of the disease may save the patient from that which is to be dreaded more than death.

Indications for operation may be narrowed down to very close limits and comprised in three groups, as follows:—

1. Severe and typical symptoms (pain, hæmorrhage, vomiting) unrelieved by prolonged treatment in bed, or recurring again and again after apparent cure.

2. Bleeding which resists all medical treatment and continues to such an extent as to be dangerous to life, and then only (a) when there have been previous symptoms of ulceration: or (b)

when the hæmorrhage is recurrent and cannot be controlled, and the patient has reached such a state of anæmia that further bleeding will probably be fatal.⁷

3. Acute ulcers complicated with certain effects of ulceration which are in themselves painful or dangerous; viz., adhesions, severe hour-glass contraction causing stenosis, pyloric obstruction, or marked dilatation.

Several methods have been devised for dealing with these conditions:—

1. Excision of the ulcer and union of the cut edges with sutures.

This is the best treatment when the ulcer is single, especially if it can be easily reached.

2. Cauterization of the ulcer has, according to Comte, been practised by Küster, and is applicable when a bleeding ulcer is beyond the effective reach of the finger.

3. The same authority says that Roux has combined excision of the ulcer with double ligature of the main trunk of the artery from which the blood issued (the coronary in this particular case).

Ligature of the main artery is indicated when the source of bleeding cannot be found. In such event the coronary should be chosen, for it has been noticed that, as a rule, the blood proceeds from the area supplied by that vessel.

4. Gastro-enterostomy has been performed with success (*a*) when ulceration is attended with obstruction at the pylorus, or with hour-glass contraction; also (*b*) in cases of hæmorrhage where the source of the flow cannot be discovered, and (*c*) where there are many ulcers.

The following cases well illustrate each of the three indications for operation. In the first, the symptoms were so recurrent, and, ultimately, so persistent and threatening, that it was clear that the patient was in extreme danger of perforation, if, indeed, it had not already taken place. In the second, hæmorrhage was persistent and incurable by medical means. In the third, there existed both active ulcers and the effects of ulceration, of such a nature as to render life miserable, and to inevitably shorten its duration.

⁷ Comte mentions as an indication "slight and frequent hæmatemesis."

CASE I.

A well-nourished but delicate-looking servant girl, of the age of 19, had suffered from three distinct attacks of dyspepsia in the course of two years. During each attack there was epigastric pain and severe vomiting; and, on two occasions, hæmatemesis. At one time she had received treatment in a hospital, but on each occasion a restriction to milk diet, together with treatment by medicines, had been sufficient to do away with her symptoms. She came to me complaining of a recurrence of the trouble in a severe form. She insisted on continuing her occupation, but was put on a milk and farinaceous diet, and treated with large doses of carbonate of bismuth and a bland preparation of iron. The symptoms gradually abated until she was able to take ordinary food without any renewal of her trouble. But I continued to see her now and then until she became stronger and less anæmic. One month then elapsed before she again applied to me for treatment. I found that she had been living a healthy life, and that there was no apparent cause for the reappearance of her disease. Treatment of a similar nature as before now failed to produce a similar effect, and after a few days I advised her to go to bed. She rapidly improved, and a fortnight afterwards, beyond occasional uneasiness after food, had lost all her symptoms. Then I was urgently sent for one night, and found she had experienced sudden and unusually severe pain at the lower part of the abdomen on the left side. I supposed that the ulcer had given way, and went to see her at once, but found that she had recovered. But on pressing the abdomen there was decided tenderness over the whole of that district, and particularly on the left side below the umbilicus. The next day, however, she appeared to be quite well. Almost a month afterwards an attack of a similar nature occurred and passed off in the same way. On both these occasions a meal had been taken not long before (two and a-half hours in the first instance, about three-quarters of an hour in the second). After this, pain and vomiting returned as badly as ever, and I again sent her to bed. While there, only a little food was given by the mouth, and for a fortnight she was fed only by the rectum. But in spite of

this she became worse rather than better. She twice had sudden and severe abdominal pain suggestive of perforation, and after one of these attacks the temperature rose above the normal, and continued slightly elevated for a few days. There was also diffuse tenderness over the abdomen. One of these attacks took place while she was taking milk only, and the other while she was taking nothing but water. During this time she became very weak, anxious, and depressed. The onset of another attack of sudden acute abdominal pain led to the question being asked whether perforation had not taken place with the escape of small quantities of stomach contents. Much doubt was expressed on this point, but it was finally decided to operate.

Chloroform was given, and an incision was made a little to the left of the linea alba. An ulcer was found without much difficulty near the greater curvature, on the anterior aspect of the stomach, at about its middle. It was apparently of the size of a sixpence, and was adherent to the abdominal wall, but the adhesions readily gave way. In order to gain room for the excision of the ulcer it was necessary to make a cut for two inches in a transverse direction, joining the original incision at right angles. Then, after thoroughly exploring the interior of the stomach for the presence of other ulcers and none being found, the ulcer was excised. Its edges were moderately thick, but the centre was so thin that the end of the finger could be pushed through it with the greatest ease. The vessels surrounding the ulcer were slightly enlarged. None of them, however, bled to any serious extent, partly, perhaps, because I did not cut away more than was barely sufficient to refresh the edges of the ulcer. Two rows of silkworm gut sutures were applied, three sutures including the whole substance of the stomach wall, and four after the manner of Lembert. Nothing escaped from the stomach. The part was cleansed with a few spongefuls of boiled water, and the abdominal wound was closed with alternate stitches of wire and silkworm gut, great attention being given to the transverse part of the incision for fear of subsequent yielding during the act of vomiting. Superficial sutures of horsehair were also used.

After recovering from the anæsthetic the patient complained much of pain at the seat of the incision. No food was given by the mouth for the first six hours, but water was administered by the rectum at intervals of two hours. Attempts were then made to feed by means of nutrient enemata of peptonised milk, but the injections were not retained. It was, therefore, thought best to begin feeding by the mouth rather earlier than was at first intended. Small quantities of peptonized milk were at first given, but retching, which had occurred two or three times before, now became so violent that the attempt was abandoned, and half a tumblerful of hot water was given instead. Retching, however, still continued, but was not increased when, after a time, a little broth was given. Then, from no apparent cause, retching and vomiting became more urgent and frequent, though the stomach was kept empty. Hot water, ice, bismuth in large doses, cocaine, and opium, were each tried in succession, but without mitigating the retching, which, on the contrary, gradually increased in frequency and severity. Not only was this distressing symptom most painful and exhausting to the patient, but it was feared that the edges of the wound would be torn asunder by the violent contractions of the abdominal muscles. Seeing that the retching went on in spite of the emptiness of the stomach, it was thought that the emptiness itself might be at the bottom of the mischief, and the patient was therefore persuaded to swallow a few mouthfuls of sopped biscuit, but with no better result. Finally, in despair of stopping the retching in any other way, chloroform was given until the patient was unconscious. The result of this procedure was so good as to at first give rise to the hope that the retching had ceased, for she fell into a sleep which lasted for some twenty minutes after the chloroform had been left off. But, unfortunately, on awaking, the retching again commenced, and after a little while became incessant. Chloroform was therefore again given, together with a subcutaneous injection of morphia, but the retching continued and only abated as she herself became exhausted. Finally she died thirty-two hours after the operation.

At the post-mortem examination it was found that the edges of the abdominal wound were already beginning to unite, and that the sutures had not cut through in the slightest degree ; moreover, the incision in the stomach looked healthy, and there was no appearance of congestion around it. Its edges were secure and were already so adherent, one to the other, that it required a perceptible effort to separate them after the sutures had been cut.

REMARKS.

It is very difficult to give a satisfactory explanation of the violent retching in this case. Among the possible causes that will be first thought of is the presence of blood in the stomach, for this in some people, apparently, is far more likely to cause sickness than in others. In support of this view it was noticed at the post-mortem examination that there was a very small quantity of altered blood here and there on the mucous membrane, and small quantities had also been present in that which had been vomited during life. But the amount lost in this way was not altogether so much as an ounce, and it seems hardly possible that it could have caused so much disturbance, especially as the stomach was well washed out. The kidneys and other organs were normal. As the retching was certainly worse after the administration of bismuth, it occurred to me to examine that drug by Marsh's test, but no arsenic nor antimony were found. The most probable explanation of the cause of the retching is that some branch of the vagus was included in one of the sutures, or was otherwise irritated by them.

May I here venture to suggest that gastric ulcers perforate far more often than is generally supposed, but that some of these perforations become rapidly sealed up and give no further trouble? This arises either from the minute size of the perforation or from its occurrence when the stomach is empty or nearly empty. Indeed, this must be almost of necessity correct, for it would be strange were the floor of every perforating ulcer to give way to such an extent as to admit of the escape of large quantities of gastric contents. It is more probable that in some cases a slow process of ulceration, if it do not cause adhesions between the two adjacent peritoneal surfaces, ends in the making of a pin-hole

aperture which allows of the escape of a few drops of irritating fluid. This leads to violent local peritonitis, and sudden severe pain, and ultimately to the complete sealing up of the aperture. This sequence of events is the more likely to happen in chronic ulcers, seeing that they are both slow in formation and conical in shape. Moreover, the apex of the cone points to the serous surface. It is certain that the subjects of gastric ulcer are liable to attacks of acute sudden pain followed by local tenderness and by slight fever, and ending in speedy recovery. I have three times seen patients immediately after such attacks, and in each the symptoms were highly suggestive of perforation having taken place. In one instance sudden and severe pain was felt while the patient was lying in bed. Dr. Hurry, who was then sent for, and to whom I am indebted for letting me see the case, was in doubt whether perforation had taken place or not. We were certain that a gastric ulcer was present, for the history of the case was conclusive on that score, and the symptoms were so suggestive of perforation that preparations were made for operation. But it was not thought right to advise that this step should be taken unless the symptoms persisted or became worse. However, the temperature, which was slightly elevated, soon became normal, pain and tenderness subsided, and the next day the patient was almost well. Food was withheld by the mouth for the first twenty-four hours, and was then given in gradually increasing quantities. No further symptoms arose, and when I last heard of her she was in good health.

I feel sure that symptoms of this nature are due in all cases to the escape of the contents of the stomach through a small aperture. I am the more certain of this, as in two of the three instances which I have seen, the pain was felt at the lower part of the abdomen, at a place in which there is frequently severe pain when larger ruptures have occurred. In one of my cases of perforation, I found, when I came to operate, that there was an isolated patch of intense inflammation in this locality, giving the impression that the fluid had dropped by the action of gravity through the open ulcer to the lower part of the abdomen. I do not see why a few drops of irritating gastric fluid should not sometimes find their

way through a minute leak in the floor of an ulcer, and give rise, in a similar way, to the slighter forms of disturbance. A case which I saw not long ago, lends still further support to this view. I was called in by Dr. Charlsley, of Slough, to see a young woman who had been subject to some of the symptoms indicative of the presence of an ulcer, and had been suddenly seized with violent pain in the abdomen. This pain came on an hour after a good meal, and was situated principally to the left of and above the umbilicus, but tenderness was present over the whole of the abdomen ; the temperature rose to 101° , and the skin became much flushed. This was in the evening, and I saw her first on the following morning. There was then no pain, tenderness was diminished, the temperature normal, the pulse 115, full. The bowels had acted, and the patient, under the influence of opium, had passed a quiet night. The view taken both by Dr. Charlsley and myself was that perforation had taken place through a small opening. It was also our opinion that the patient might do well without an operation, but that it was much safer that the ulcer should be sought for and closed. She was in excellent condition for undergoing an operation, and the locality of most intense pain suggested that the ulcer would be easy to reach. The operation was therefore performed, and an ulcer found on the anterior surface near the greater curvature, and nearer the pyloric than the cardiac end. The ulcer was adherent to the anterior abdominal wall by recent adhesions. There was no escape of stomach contents and the actual peritonitis was confined to the immediate neighbourhood of the ulcer, though the veins of the adjacent peritoneum were much distended. The perforation was too small to be detected by mere inspection, but a probe passed lightly over the surface at once went into the stomach. The ulcer was not excised, but its walls were brought firmly together by means of silk sutures, and covered with folds of peritoneum. The patient made an uneventful recovery.

Such a case as this shows that ulcers sometimes perforate by such small holes that nothing but a little acid fluid can escape through them. Probably this also is the explanation of some of those cases in which a perforation has been left to take care of

itself and the patient has recovered.¹ It is noteworthy that in both Dr. Charlsley's case and in that which I have detailed more fully the ulcer was on the anterior surface. This was an additional indication for operation, for two reasons. Ulcers on that surface are not only easier to get at, but they are also more deadly, for the part is more mobile and adhesions are, therefore, less likely to be secure. This, in all likelihood, accounts for the four separate attacks of violent pain which I noticed in my case. Each time probably some gastric fluid escaped through a minute opening, and, except on the last occasion, each time the adhesions were rendered useless by the mobility of the stomach and abdominal wall.

CASE II.

This patient was a married woman of the age of thirty, who had had three children. She had been subject to severe anæmia when about eighteen years of age, but had never had any form of dyspepsia. Hæmorrhage was the one and only symptom. It began at about 2 a.m., while she was in bed, and could not be attributed to any particular cause. She had not been out of health, nor had she eaten an unusually heavy or indigestible meal. She brought up about a pint of food and blood together, and an hour afterwards vomited nearly four ounces of altered blood. When I saw her on the following morning I at once stopped all food by the mouth, but allowed her to drink water. She was fed by means of nutrient enemata. After continuing in this way for two days, a little peptonized milk was mixed with the water, and the proportion of milk was gradually increased. Farinaceous food was then allowed, but about two hours after she had commenced this, and four days after the first hæmatemesis, she again brought up a small quantity of blood, and continued to do so at intervals for about twenty-four hours. It was only too evident that the best policy was to withhold all food by the mouth for a much longer period. She was, therefore, fed per rectum for ten days, nothing but ice and water being given by the mouth.

¹ Dr. C. Pariser has found no less than fifteen instances. (*Zur Behandlung des Frei in die Bauchhöhle perforirten ulcus ventriculi.* Deutsche med. Wochenschr., July 18, 1895, p. 467.) He accounts for recovery on the supposition that rupture occurs a long time after a meal, when the stomach is empty.

At the end of that time she was given a little grape sugar, but this was so distasteful, and caused such nausea, that raisin juice was substituted, and she was also given some infusion of malt. But this had not been commenced for longer than four hours, when the bleeding recommenced, and continued at intervals, in spite of the stomach being kept empty. The only active methods made use of to check the hæmorrhage were half-drachm doses of the strong solution of perchloride of iron, given every four hours, and hot water. The hot water was highly appreciated, and the greater the heat the better she liked it. I myself saw her, on one occasion, drink water which was poured boiling out of a kettle into a feeding cup and given to her without delay, and then she remarked that it was not hot enough. At this time the anæmia was profound, nothing would stop the hæmorrhage, and she could not retain the nutrient enemata. The prospect was not hopeful. It was, therefore, decided to open the abdomen and search for the lesion. This was done fifteen days after the first appearance of the hæmorrhage. The opening was made in the epigastric region, a little to the left of the middle line, but after a careful search no sign of the ulcer could be detected. The stomach was, therefore, cut into and the finger introduced, but again without success, though the mucous membrane was not only explored with the finger, but was inverted into the incision and examined with the eye. The wound in the stomach was, therefore, closed with silk sutures, and that in the abdominal wall with silkworm gut and horsehair.

After the operation she was fed by the mouth with peptonized milk, broth, and peptonized food in small quantities, but after two days a feeling of extreme faintness announced that the hæmorrhage had recurred, and shortly afterwards she vomited a small quantity of black material. Meanwhile an attempt had been made to resume the nutrient injections, but without success. It was found that nothing gave her so much relief, nor apparently did her so much good as enemata of opium and alcohol, of which 40 minims of the former ("sedative solution") and six ounces of the latter were given in twenty-four hours. These diminished the rapidity of the pulse, and improved its character,

without causing flushing or any other symptom of narcotism. But though all food was again withheld from the mouth, attacks of faintness or of hæmatemesis continued, and the patient sank nine days after the operation.

After death, an incision was made close to, and parallel with the scar of the operation wound, in order to rehearse the steps of the operation as nearly as possible. It was found that this abdominal wound was firmly healed, and was not adherent to the parts beneath. I was astonished to find a large ulcer lying almost immediately beneath it, and so near that it came into view with hardly any disturbance of the parts. This ulcer was 3 c.m. in diameter, was situated on the posterior surface 5 c.m. from the pylorus and was attached by its edges to the pancreas, so that that organ formed its floor. The attachments were separated with the greatest ease, giving hardly any sense of resistance, and leaving no perceptible mark. The edge was sinuous, abrupt, and not thickened in the slightest degree. A search was made for the end of the vessel which was the source of hæmorrhage, but without success. No other ulcers could be found. The wound made in the stomach at the time of operation was completely healed. All the organs were blanched and nearly the whole of the large intestine, and a great portion of the small, were filled with masses of dark slate-coloured, pultaceous material, consisting largely of altered blood.

REMARKS.

The most striking feature of this case, next to the non-appearance of the ulcer at the time of operation, was its appearance ten days afterwards. I am certain that there was no ulcer larger than a millet seed at the time of the operation, and the stomach was so pulled, first in one direction and then in another, that it is impossible that an ulcer which had eaten through the thickness of the stomach could have escaped being torn from its attachments. I am certain that the ulcer which I saw at the post-mortem examination had formed almost entirely within the ten days that had elapsed since the operation, though it seems equally certain that a minute aperture had existed from the first onset of hæmorrhage. The case is of interest, too, from being one of those in which an

operation is certainly justifiable and yet does not hold out much prospect of being attended with success. There was no history of previous ulceration, and the hæmorrhage came on acutely and was but little influenced by treatment; it was, in short, just such a case as those I have before alluded to in which other operators failed to find the source of bleeding. I operated while under the impression that further hæmorrhage would be fatal, but the event proved that I might have waited a few days longer. Had I done so I should almost certainly have found the ulcer which subsequently became so conspicuous.

CASE III.

This patient was a domestic servant of the age of thirty-two, who had suffered from symptoms of gastric ulcer since the age of eighteen. The history of her life since the latter date consisted of long periods of dyspepsia, of nausea, vomiting, pain, and bleeding, one or other of which was never absent, though there were occasional periods of comparative ease. Her aspect was one of extreme dejection, and she had been under treatment by so many doctors, and with such little success, that she despaired of ever being well again. Her work had been so often interrupted by the necessity for rest that, were it not for the philanthropy of a former mistress, she would have been unable to obtain a livelihood. The symptoms of the previous three or four years had apparently been those of obstruction at the pylorus, for one of her most harassing trials was the vomiting of enormous quantities of liquid. These vomiting attacks followed a regular sequence; first came a period during which she felt comparatively well and could eat food, then came a period of epigastric pain and anorexia, ending at last in copious vomiting and relief. The fluid brought up was not often mixed with undigested food. It sometimes contained a black sediment. During the three months that she was under my observation I found that it frequently contained blood, though never in large quantities. One symptom which much puzzled me at the time was an occasional gurgling, which was very distinct, and very different from the usual intestinal gurgling. It seemed to bear no relation to position, or to fulness, or emptiness of the stomach. I found that the patient was best

when in bed, and fed almost solely by the rectum, but that whenever mouth-feeding was resumed, were it only with milk and thin farinaceous foods, the pain and vomiting were certain to recur. Large doses of bismuth certainly relieved the pain, but had no effect on the vomiting. After treating this patient for some three months without making any real headway, she was told that her only hope lay in an operation, and this she consented to with alacrity. I thought at the time that she was suffering from stenosis of the pylorus, and that the ulcer which caused the stenosis was still unhealed.

But at the operation a much more complicated condition was found.

In the first place, the stomach was so bound down by adhesions that it was impossible to explore more than a few inches of its outer surface.

Secondly, it became evident, on cutting into it, that there was no obstruction at the pylorus, but that the stomach was hour-glass shaped, the upper part being much larger than the lower (Fig. 1). The stenosis, in fact, occurred between the two com-

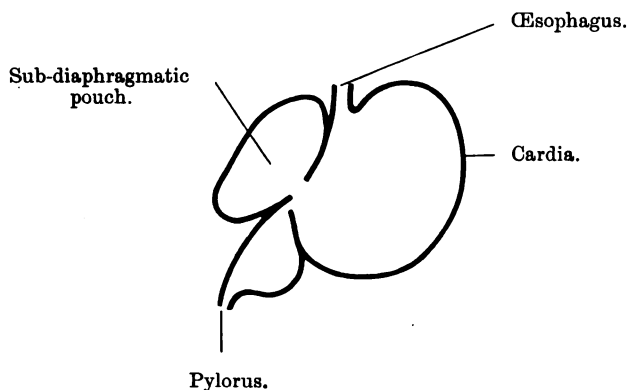


Fig. 1.

partments, and was so complete, that one could only force one's finger into it, and then with difficulty. The septum between the two divisions of the stomach was found to be so steep that it seemed impossible that any food could ever have found its way through the opening, except when the upper cavity was full, or

when it was squeezed through the opening during the act of vomiting.

On turning the finger upwards a third anomaly was found. This at first appeared to be a third compartment to the stomach, lying between the lesser curvature and the liver and the diaphragm, for on bending the finger into this part it ran into a cavity which was far too extensive to be explored, except at its junction with the stomach. It appeared pretty certain that an ulcer had at one time existed at this spot, that it had perforated and ultimately formed an adventitious cavity into which the contents of the stomach had probably made their way during vomiting, and perhaps on other occasions. No active ulcers could be found. It was noticed that the intestines were very small and thin walled. The stenosis was dealt with after the manner devised by Heineke and Mikulicz. The incision permitted all four fingers to be introduced through the passage. The first part of the stomach was now explored for ulcers but none were found. It was, however, so distended that only a very small part of it could be touched with the fingers. The wound in the stomach was sutured with horse-hair, but the tissues cut through were so stiff and cartilaginous in consistency that there was some fear lest leakage should occur, though the wound seemed to be well closed; a small drainage tube was therefore used.

The patient soon recovered from the operation, and after two days was fed by the mouth. On the fifth day there was a little vomiting, and the vomit contained some altered blood. The patient was kept on her right side so as to facilitate the passage of food into the intestines. No vomiting of any quantity now occurred, but there was slight emesis now and again, and the vomit always contained small quantities of blood. Pain was still felt after food, but to a less degree. The wound healed well, and sixteen days after the operation the patient was allowed to go home. She was improving rapidly, was taking food well, but was still giving rise to anxiety by the continuance and character of the vomiting. Owing to this cause, though she was allowed to sit up, she was kept at rest, and food was restricted to easily digested

slops. Bismuth was also given. She continued in this condition until exactly a month after the operation, when I was hurriedly sent for and found that she had suddenly felt faint, and a few minutes afterwards had vomited large quantities of black vomit. Hæmorrhage continued despite all efforts to stop it, until she died on the next day.

On examination after death, it was found that the external wound had healed completely, but that the wound in the stomach was still unhealed in one part. This was where the cicatricial tissue was thickest. Three very chronic looking ulcers were found in the dilated first part of the stomach. The adventitious sac which existed above the stomach had partially filled since the operation, but was still perceptible. The source of the hæmorrhage was apparently the unhealed part of the wound which had been made in the septum between the two stomach cavities, though no actual source of hæmorrhage could be found. The contraction itself seemed to be of the nature of a malformation, for no scars of ulcers could be detected upon it, and it appeared too uniform to be due to cicatrisation. Very little blood was found in the intestines. The body was much emaciated.

REMARKS.

There can, I think, be no doubt that the method of treatment in this case was correct, for though it would have been better to have made a communication between the stomach and the small intestine the adhesion of the stomach to adjacent parts rendered this impossible. It is probable that these adhesions were formed at the same time as the adventitious cavity under the liver, both being brought about by the same cause, *i.e.* a perforation. This perforation had probably led to widespread inflammation about the stomach and was sufficiently severe to lead to the formation of a sub-diaphragmatic abscess. The abscess had then burst through the ulcer into the stomach. Owing to the hour-glass shape of that organ, food had then found its way into the abscess cavity and so the opening had been kept patent and after a time an accessory stomach had been formed. The gurgling which I had noticed during life had no doubt proceeded from the passage of liquid from this cavity.

It may be said that this case does not come within the scope of this article for no ulcer was operated upon, but, inasmuch as it presented itself as a case of ulceration and ulcers were present, I hope that its insertion is justified. One of the conditions for which operation is justifiable is the presence of an ulcer in conjunction with stenosis, and this was an instance of this conjunction though the stenosis masked the other symptoms.

CONCLUSIONS.

1. Generally speaking, the prognosis of gastric ulcer is good; its treatment by medicine and rest is attended with success. But cases sometimes arise which show a marked tendency to perforation, or hæmorrhage, or to become complicated with stenosis. Should these cases prove intractable it is justifiable to operate upon them.

2. The results of the operations which have been recorded are not encouraging, for out of eleven cases, which I have been able to find of operation for uncomplicated gastric ulcers, six were unsuccessful. Nevertheless, there is reason to suppose that this does not represent the mortality that may be expected in the future, for those which have been done were, as a rule, only attempted because of the extreme gravity of the symptoms. It is probable that further experience will lead to a better selection of cases and to improved methods of operating.

3. In selecting cases for operation it is above all things necessary to beware of those in which hæmorrhage is the only symptom. In certain grave cases it may be legitimate to operate under these circumstances, but only further experience can enable us to say whether it is advisable.

4. There is reason to believe that ulcers perforate much more frequently than is generally supposed. Perforation probably occurs with all degrees of severity, between minute apertures which occur when the stomach is empty and therefore give rise to few symptoms, to perforations of such a fulminating character that death takes place almost immediately. It is the more severe which demand speedy operation and are published under the name of perforated gastric ulcer, while the less severe are

probably either not recognised, or if recognised are not thought worthy of being reported.

5. The formation of acute ulcers may be very rapid, so rapid in fact, that a hole 3 c.m. in diameter may be made within a fortnight.

6. When the ulcer has been sutured a dangerous complication may set in which has not hitherto been described; this is retching. It may prove uncontrollable and be the direct cause of death.

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AN ACCOUNT OF SOME CASES OCCURRING IN THE MAIDSTONE TYPHOID FEVER EPIDEMIC.

By T. BRICE POOLE, M.D.

(COMMUNICATED BY THE EDITORS.)

THE following remarks refer to a series of cases which came under my notice whilst acting as Superintendent of the Emergency Hospitals during the above epidemic, which occurred in the last four months of 1897.

At the outset I must apologise for the meagreness of the notes of these cases, which are taken from my report to M. A. Adams, Esq., F.R.C.S., the Medical Officer of Health of Maidstone; but it will be readily understood that without employing a much larger medical staff than was adequate to treat the patients, it was practically impossible to keep a uniform detailed report of the course of each illness; and when it is remembered that the buildings which had to be hurriedly fitted up, furnished, and converted into hospitals (the technical part of which was superintended by various members of the Special Emergency Committee of the Sanitary Authority) were separated from each other by considerable distances, and that most of the patients were seen by one of the medical staff before their admission, it will be unnecessary to say that our time was fully occupied.

As the occasion, however, is an exceptional one, I hope that the record of these cases, however incomplete, will not be totally void of interest

With regard to the cause of the outbreak, little need be said; a most complete report on the subject has already been presented by Mr. Davy, Dr. Theodore Thomson, and Mr. Willcox, the Commissioners who conducted a public enquiry into the matter for the Local Government Board in January last.

The main facts are these :—There was undoubted evidence of contamination with animal excreta of the section of the town's water-supply derived from the Farleigh springs, as shown by chemical and bacteriological examination of the water; and that this contamination was the cause of the outbreak is supported by the very high rate of incidence of typhoid fever amongst persons living in the area of the town to which this water was distributed, compared with those living in areas supplied with water from other sources.

The sufferers first attacked fell ill during the last week in August, but it was not until the beginning of the third week of September that notifications of the disease reached the Medical Officer of Health in such numbers as to cause grave alarm, and from this time until the end of October fresh notifications flowed in rapidly. The figures are as follows :—

Week ending	Notifications.	Attacks. ¹
August 28	—	4
September 4	—	29
" 11	2	165
" 18	128	434
" 25	544	432
October 2	529	274
" 9	246	134
" 16	116	64
" 23	61	45
" 30	44	33

The delay in notifying the earliest cases is not to be wondered at, since several days must necessarily elapse between the onset of the

¹The date of attack was arrived at by making enquiries about every notified case.

illness and the appearance of the rash confirming the diagnosis ; and the sudden rush of notifications immediately afterwards, when it became known that an epidemic existed, is only what one might expect, as medical men would then have no hesitation in notifying cases as typhoid when they presented many early symptoms of the disease.

A Special Emergency Committee of the Sanitary Authority was formed to consider the question of housing the sufferers who could not be properly nursed at their homes, with the result that, between September 25th and October 28th, no less than twelve buildings were fitted up as temporary hospitals, providing accommodation for 339 patients. These buildings consisted of school rooms, mission halls, the " Salvation Army " barracks, a private house, a group of " Berthon " huts, and one block of the permanent Fever Hospital. They were so situated as to form ten separate hospitals,—five on each side of the river Medway, which runs through the town. Two of these hospitals were reserved for the transfer of patients who had reached convalescence, but who were not then well enough to be discharged.

Three hundred and eighty-one patients in all were admitted into these hospitals—210 into those on the eastern side of the river, and 171 into those on the western side.

It is to the former 210 cases, which came more particularly under my notice, that this paper refers, the western hospitals being under the medical superintendence of Dr. Russell.

The first patients were admitted on September 25th, 1897, and the last were discharged on March 28th, 1898.

I have added, as an Appendix to this paper, brief notes of each case to which frequent reference will be made, and it will therefore save much repetition.

Of these 210 cases, 103 were males and 107 females.

The average stay in the hospital of each patient was sixty-two days. This period was much prolonged by the occurrence of sore-throat and diphtheria amongst the inmates, also by precautions taken against importation of typhoid fever into other districts through relapse occurring after a patient's removal to a Convalescent Home. That this fear of late relapse was not unfounded is

illustrated by a case in the private practice of a medical man in the town, in which a relapse occurred after the patient had left her home, and five weeks after convalescence had commenced.

I have arranged these cases into two classes.

The first class includes all undoubted cases of typhoid fever, which were in the active stage of the disease during some period of their stay in the hospital; and of these there were 183.

The second class includes the cases which had reached convalescence when admitted, and did not relapse subsequently, and those in which the diagnosis was doubtful; of these there were twenty-seven.

It is only to the first class, except where otherwise indicated, that this collective consideration refers.

Age.—Forty patients, or 22 per cent., were under 10 years; ninety-five, or 52 per cent., were under 15; one hundred and twenty-six, or 69 per cent., were under 20; one hundred and forty-two, or 78 per cent., were under 25; and one hundred and fifty-three, or 84 per cent., were under 30; thirty, or 16 per cent., were over 30.

The large proportion of cases occurring in the young is not to be wondered at, since the disease was water-borne, there being undoubtedly a much larger proportion of water drinkers amongst children than amongst adults.

Severity.—In Tables I. and II., I have arranged the cases in three groups, according as the attacks were (a) severe, (b) moderately severe, or (c) mild.

The classification as to severity is a purely arbitrary one, but will serve to furnish a means of comparison.

In Table I., I have further sub-divided them according to *age-distribution*, and in Table II. according to *attack-period*. In sub-dividing them I have also shown the numbers of each group in terms per cent. of the total number of cases belonging to the same age- and attack-periods.

From the totals it will be seen that the cases are almost equally distributed between the three groups.

TABLE I.—AGE-DISTRIBUTION AND SEVERITY.

Age....	Severe.	Moderately Severe.	Mild.	Totals.	Deaths.
Under 5 years	2	3	4	9	—
5 to 10 "	5	11	15	31	1
10 to 15 "	18	18	19	55	4
15 to 20 "	13	6	12	31	1
20 to 25 "	4	6	6	16	1
25 to 30 "	2	5	4	11	—
30 to 35 "	3	5	2	10	1
35 to 40 "	5	5	2	12	1
40 to 45 "	2	2	—	4	—
45 to 50 "	2	—	1	3	—
60 "	1	—	—	1	1
Totals	57	61	65	183	10

TABLE II.—ATTACK-PERIOD AND SEVERITY.

Date of Attack.	Severe.	Moderately Severe.	Mild.	Totals.	Deaths.
Sept. 1 to 7	1	—	—	1	1
" 8 to 14	6	8	2	16	2
" 15 to 21	18	9	14	41	2
" 22 to 28	10	14	17	41	1
" 29 to Oct. 5	9	16	11	36	1
Oct. 6 to 12	5	6	9	20	2
After Oct. 12	8	8	12	28	1
Totals	57	61	65	183	10
	31 per cent.	33 per cent.	36 per cent.		

In Table I., it will be noticed that the largest proportion of severe cases occurred in patients between the ages of 10 and 20, and after 30 years.

The earlier cases in the epidemic were undoubtedly generally more severe than the later ones. To illustrate this I may mention that of the first thirty cases admitted to the Emergency Hospitals, no less than five died, whilst there were only the same number of deaths amongst the 153 subsequently admitted.

From Table II. it will be observed that the proportion of severe cases was largest amongst those who were attacked during the second and third weeks of September, and the proportion of mild cases was smallest among those attacked during the second week of the same month; also that of 58 cases whose illnesses commenced during the first three weeks of September, five died, whilst there were only the same number of deaths amongst the 125 patients attacked subsequently; in other words, the mortality amongst the former was more than twice as great as amongst the latter. There is, however, a source of fallacy which must not be overlooked; in the early days of the epidemic, when hospital accommodation was limited, admission was first offered to the most necessitous cases, which were often the most severe ones.

The early cases were characterized by more sudden onset and severe headache, which was soon followed by noisy delirium, that is to say they presented the symptoms of a sudden and severe toxæmia. The commencement of the illness was at first frequently mistaken for influenza.

Why should the early cases be generally more severe than the later ones? Several possibilities have occurred to me.

I. Supposing, the virulence of the bacillus to have been constant, is it not possible that the first affected, that is to say those affected with the least quantity of the virus, were the more susceptible, and therefore the severer cases?

II. Was the specific poison in the water more virulent because it was less diluted?

If, as it has been supposed, some typhoid infective matter was accidentally washed, directly or indirectly, into a collecting tank during a downfall of rain, and if the water containing the infective

matter was afterwards pumped into a reservoir, it is only reasonable to suppose that, as the water was being rapidly drawn off from the reservoir whilst water of a purer nature was at the same time being pumped in to replace it, the infective matter in the reservoir would become progressively more diluted according to the time which had elapsed since the water was first contaminated.

III. Was it because the earlier cases were drinking typhoid-infected water, not only until the commencement of their illness, but also for some time afterwards, since the water was not then recognized as being at fault, whilst the later cases ceased to drink the water after contamination had been observed, which, in many cases, was before their attacks commenced?

The growth of infective bacteria is necessarily accompanied by the formation of toxins, and if the water contained suitable material on which the contained typhoid germs could grow, toxins might be produced; and is it not possible that, if an individual drank this toxin containing water, and the typho-toxin was absorbed by the vessels of the stomach and so passed into the general circulation, it might contribute to produce this rapid and intense toxic effect?

One would expect that the pyrexia accompanying the onset of the illness would cause great thirst; also that the patients would try to assuage this thirst with draughts of water; and if the water contained toxic products, such an occurrence might be compared to a drunken man continuing to take alcohol after he was already intoxicated, with the inevitable result that he would become more intensely intoxicated.

Table III. gives an analysis of the duration of the fever in 154 cases.

This period corresponds to the time which elapsed between the day when the first symptoms were noticed and the complete subsidence of the pyrexia. The day of onset was often extremely difficult to fix, and required much judgment.

The fatal cases, and those which were admitted on account of relapse, as well as a few in which the duration of the fever was very uncertain, have been excluded from the table.

TABLE III.—DURATION OF FEVER.

Week of illness in which pyrexia completely subsided.	2nd	3rd.	4th.	5th.	6th.	7th.	8th or later.	Total.
Children	12	23	28	11	6	1	2	83
Adults	—	18	20	16	6	6	5	71
Children and Adults	12	41	48	27	12	7	7	154
Proportion of Total ...	8 %	27 %	31 %	17 %	8 %	4½ %	4½ %	

From the above Table it will be seen that, of the twelve patients whose illness ran a course of less than a fortnight, all were children (*i.e.*, under the age of 15) ; that the total numbers of cases of children and adults respectively, whose pyrexial period terminated in the third and fourth weeks of their illnesses, were almost equal in proportion ; and that it was more common for the pyrexia to be prolonged after the fourth week in adults than in children. Further, it shows that in 31 per cent. of the cases the fever terminated in the fourth week, in 27 per cent. in the third week, in 17 per cent. in the fifth week, in 8 per cent. in the second and sixth weeks respectively, whilst in 9 per cent. it did not terminate until after the sixth week.

In several cases it was difficult to arrive at a conclusion as to whether, after an apparent slight defervescence, followed by a further rise of temperature, the latter period should or should not be considered a relapse.

As regards the highest degree of pyrexia recorded in each patient during his stay in the hospital, making an analysis of 175 cases, I found that in 168 the thermometer registered 102° or over ; in 152 cases 103° or over ; in 94 cases 104° or over ; in 24 cases 105° or over. There were three cases in which the temperature reached over 106° .

These temperatures refer solely to records taken during the patients' stay in the hospitals, and it is probable that higher temperatures occurred in many cases previous to their admission.

Of the ten fatal cases the thermometer registered 108° in one case ; $105\cdot2^{\circ}$ in another case ; between 104° and 105° in seven cases ; and between 103° and 104° in the tenth case.

Only one death occurred amongst 81 patients whose temperature did not reach 104° , whilst there were nine deaths amongst 94 patients whose temperature was, at some time, above that point.

Of the three cases of hyperpyrexia, all were males, and one died.

In Case 61 (Chart VII.), a man *æt.* 35, a rigor, no doubt brought about by the patient hearing news of his wife's serious illness, was

followed by a rise of temperature to 106.2° on the 18th day of the fever.

In Case 94 (Chart X.), a boy *æt.* 14, a temperature of 106.4° occurred, shortly after his admission to the hospital, at the commencement of a relapse. Several rigors followed in the course of the next few days.

In Case 185 (Chart IV.), a man, *æt.* 44, who presented symptoms of perforation and peritonitis, the thermometer registered 108° on the sixteenth day; death followed shortly afterwards, although the temperature was rapidly brought down to 101° by the application of ice to the body.

Dr. Bryant² states that between the years 1879 and 1893 inclusive, 608 patients suffering from typhoid fever were admitted into the wards of Guy's Hospital; 99, or 14 per cent., died. In six (or about 1 per cent.) hyperpyrexia (temperature above 106°) was noted, and of these three died, which gives about .5 per cent. as the mortality from this complication. The mortality in the six cases in which this complication occurred was 50 per cent. In two of the three fatal cases the hyperpyrexia was of the pre-agonistic type (as was Case 185). All six were males; the age varied from eleven to thirty-seven; five (or 83 per cent.) occurred in the months of July, August, and September; the hyperpyrexia varied from 106.2° to 107° . One case with temperature 106.8° recovered; also one with temperature 106.6° , and one with temperature 106.2° ; there were two fatal cases with temperature 106.4° , and one with temperature 107° . Hyperpyrexia was noticed on the fifteenth, seventeenth, twenty-seventh (twice), thirty-second, and sixty-second days of the disease. Rigors were noticed in one case, and there was a history of rigors in two; one patient was a heavy drinker; there was a history of previous rheumatism in one; and one case was complicated with phthisis.

Wunderlich³ states that the temperature sometimes rises before death to 108° or 110.3° , independently of complications, and that there is great danger if the temperature rises to 106.6° , when the best that can be hoped for is a very tedious recovery. He has

² "One hundred Cases of Hyperpyrexia," Guy's Hospital Reports, 1893.

³ "Medical Thermometry," New Sydenham Society, 1875.

seen a patient recover after a temperature 107.825° has been reached (during a rigor in the course of the disease). In the St. Thomas's Hospital Reports, 1895, page 248, a case is recorded in which recovery followed a rise of temperature to 110° after a rigor.

Pepper⁴ and Osler⁵ also mention the occasional occurrence of hyperpyrexia before death. Fagge⁶ states that death from hyperpyrexia is rare.

Table IV. shows the highest body-temperatures of the patients in each week of the fever during their stay in the hospital. The figures in brackets indicate the number of deaths that occurred amongst cases referred to in the same section.

The table shows that of 120 cases in the hospitals during the second week of the fever, in 57 (or 47 per cent.) the thermometer registered 104° or over, of which five (or 9 per cent.) died; that of 129 cases in the hospitals during the third week, in 38 (or 29 per cent.) the temperature was 104° or over, of which five (or 13 per cent.) died; that of 82 cases in the hospital during the fourth week, in 11 (or 9 per cent.) the temperature was 104° or over, of which two (or 18 per cent.) died; and that of 33 cases in the hospital during the fifth week of the fever in ten cases the temperature reached 103° , of which one (or 10 per cent.) died.

It will be noticed that the prognosis was much less favourable when the temperature reached 104° in the second week than when it remained below that point, and that it was progressing still less favourably when the temperature reached 104° in the third and fourth weeks.

The Pulse.—Table V. gives an analysis of the highest pulse-rates recorded in adults and children respectively for each week of the fever during their stay in the hospital. The figures in brackets indicate the number of deaths that occurred subsequently amongst cases referred to in the section of the table in which they are placed. Unfortunately, in a few cases a record was not kept; this accounts for the slight difference in

⁴ Pepper, "Theory and Practice of Medicine."

⁵ Osler, "Principles and Practice of Medicine."

⁶ Fagge and Pye-Smith, "Principles and Practice of Medicine."

TABLE IV.—HIGHEST TEMPERATURES DURING EACH WEEK OF FEVER.

Temperature.	1st Week.	2nd Week.	3rd Week.	4th Week.	5th Week.	6th Week.	7th Week.
108° ...	—	—	1 (1)	—	—	—	—
106° to 107°	—	—	1	—	—	—	—
105° to 106°	3	7 (1)	6	1	1	1	—
104° to 105°	8	50 (4)	30 (4)	10 (2)	3	1	1
103° to 104°	10 (1)	39 (1)	42 (1)	17 (1)	6 (1)	6	1
102° to 103°	4	17	32	23	12	2	2
101° to 102°	5	6	9	22	6	3	2
100° to 101°	—	1	8	9	5	6	—
Totals ...	30	120	129	82	33	19	6

TABLE V.—RECORDS OF HIGHEST PULSE-RATES.

Pulse-rate.	1st Week.		2nd Week.		3rd Week.		4th Week.		5th Week.		6th Week.	
	Adults.	Childn.	Adults.	Childn.	Adults.	Childn.	Adults.	Childn.	Adults.	Childn.	Adults.	Childn.
Over 150 ...	—	1	1 (1)	3	2	1	1 (1)	1 (1)	---	—	—	—
140 to 150 ...	—	1	3 (2)	10 (2)	4 (2)	11 (1)	—	3 (1)	2	3 (1)	1	1
130 to 140 ...	1	2	4 (1)	11	5 (1)	11 (1)	3	4	1	2	1	1
120 to 130 ...	5 (1)	9	15 (2)	20	17	14 (1)	10	11 (1)	6	2	4	4
110 to 120 ...	1	1	10	7	12	12	10	6	3	3	2	—
100 to 110 ...	4	—	13	6	14	7	9	8	1	1	4	1
Below 100 ...	2	—	6	1	10	4	7	4	5	—	1	—
Total ...	13	14	52	58	64	60	40	37	18	11	13	7

the total number of cases for each week between the temperature and pulse-rate tables.

On looking at the above table it will be noticed that of 13 adult patients in the hospital during the first week of the fever, in six cases the pulse was 120 or over, and that of these one (or 17 per cent.) died; that of 52 adult patients in the hospital during the second week of the fever, in 23 cases the pulse was 120 or over, and that of these six (or 26 per cent.) died; that in eight cases the pulse was 130 or over, of which four (or 50 per cent.) died; that in four cases the pulse was 140 or over, of which three (or 75 per cent.) died. In other words, the death-rate amongst adults was directly proportional to the rapidity of the pulse in the second week of the fever.

Of 64 adults in the hospital during the third week of the fever, in 11 cases the pulse was 130 or over, and of these three (or 27 per cent.) died. No adult patient died after the twenty-second day of the disease.

In children the rapidity of the pulse during the earlier weeks of the fever proved to be of much less importance than in adults. Thus, of 58 children in the hospital during the second week, in 44 cases the pulse was 120 or over, and of these two (or $4\frac{1}{2}$ per cent.) died; in both of these fatal cases the pulse was over 140.

Of 60 children in the hospital during the third week, in 37 cases the pulse was 120 or over, and of these three (or 8 per cent.) died. Of 37 children in the hospital during the fourth week, in 19 cases the pulse was 120 or over, and of these three (or 16 per cent.) died; in four cases the pulse was over 140, and of these two (or 50 per cent.) ended fatally.

Condition of Bowels.—The bowels were constipated in about 50 per cent. of the cases throughout their stay in the hospital; the period which elapsed before each patient's admission into the hospital has not been taken into account.

I have compiled Table VI. to show the relative frequency of constipation and diarrhœa in each week of the fever.

It will be noticed that constipation occurred in 76 per cent. of the cases during the first week, and in about 60 per cent. during each of the five following weeks.

TABLE VI.—CONDITION OF BOWELS.

No. of Stools per diem.	1st Week.	2nd Week.	3rd Week.	4th Week.	5th Week.	6th Week.
More than 6	1	1	5	3	1	1
	4 %	1 %	4 %	4 %	3 %	6 %
4 to 6	...	22	31	4	2	2
		21 "	25 "	5 "	7 "	11 "
1 to 3	5	21	16	26	8	4
	20 "	20 "	13 "	32 "	28 "	22 "
Average of less than 1	19	63	70	48	18	11
	76 "	59 "	57 "	59 "	62 "	61 "
Totals	25	107	122	81	29	18

The bowels were opened more than four times a day in 4 per cent. of the cases in the first week, 22 per cent. in the second week, 29 per cent. in the third week, 9 per cent. in the fourth week, 10 per cent. in the fifth week, and 17 per cent. in the sixth week; that is to say, diarrhœa of a severe nature occurred most frequently in the third week of the fever.

Speaking generally, steps were taken to check diarrhœa when more than four liquid stools were passed in twenty-four hours.

The above table does not include the ten patients who died; in four of them death occurred within three days of their being admitted, and as these four cases were amongst the earliest admissions I unfortunately have no accurate record on this point; one at least had profuse diarrhœa, with incontinence of fæces and urine.

Of the six remaining cases, five had profuse diarrhœa for a long period, whilst the sixth had slight diarrhœa, with as many as three stools a day. In three of these cases there was incontinence of fæces and urine. In the majority of the fatal cases, therefore, there was profuse diarrhœa.

Murchison⁷ states that diarrhœa is the rule and constipation the exception. On investigating 100 cases he found that diarrhœa occurred in 93; later, on making another analysis, he found that about one-fifth of his cases had constipation throughout the illness. He further writes, "No fact to me appears better established than that the severity and danger of the disease are in direct proportion to the intensity of the diarrhœa." This statement would certainly apply to this series of cases.

Osler,⁸ making an analysis of 389 cases of typhoid admitted to the Johns Hopkins Hospital during six years, found that in 117 cases the bowels were loose (*i.e.*, in 30 per cent.); in 36 of these the movements were frequent, in 81 moderate or slight. The majority were subjected to the "cold-bath treatment."

Murchison gave the mortality-rate of a large number of cases coming under his notice (of which the hundred cases he investigated as regards diarrhœa may be taken as a type) as 19 per

⁷ Murchison and Cayley "Continued Fevers."

⁸ Johns Hopkins Hospital Reports, Vol. V.

cent. The mortality amongst Osler's 389 cases was 8·7 per cent.; and amongst the 183 cases here recorded 5·46 per cent.

These figures show that in these last two series of cases, where diarrhœa was much less frequent than in Murchison's series, the mortality was very much lower. The frequent absence of intestinal symptoms was undoubtedly a marked feature in the Maidstone Epidemic; but judging from the cases that Osler analysed, most of which I suppose were sporadic cases, it appears that diarrhœa is a much less constant symptom of typhoid fever now than in Murchison's time; and does it not indeed seem probable that hydropathic treatment has much to do with reducing it?

Rash.—It is estimated that the rose rash appeared in about 88 per cent. of the cases. This statement is based upon the results of an examination of the whole body daily in a certain number of cases. Without such thorough examination the rose spots might have been easily overlooked. It was not thought advisable to carry out this thorough examination in every case, after a warning had been given against patients being moved unnecessarily by the occurrence of a syncopal attack in a young woman (Case 10), when she was being moved for the purpose of examining the bases of her lungs.

There was no constant relation between the profusion of the rash and the severity of the disease. Severe attacks were in some cases accompanied with profuse rash, whilst in others scarcely a rose spot could be seen. The rash was more frequently absent in young children than in adults.

Rashes other than the usual typhoid roseola occurred in the following eleven cases:—Nos. 5, 9, 105, 139, 140, 142, 144, 166, 171, 121 and 123 (the last two cases belong to Class II.). Six were males and five were females; five were adults and six were children. A brief description of the rash in each case will be found in the appendix; they include erythematous, urticarial, scarlatini-form and morbilliform rashes. The rashes appeared, in four cases, on the sixteenth, nineteenth, twentieth, and twenty-first days of the fever respectively; in two cases during the last few days of the primary attack; in two others at the end of a relapse; and

in the remaining three, early in convalescence; in other words, all the rashes appeared in the third week of the disease or later, when ulceration of Peyer's patches might be expected to have taken place. All were associated with constipation. There was tonsillitis in none. In eight cases an enema had been administered within two days of the appearance of the rash; in one case within four days; whilst in two cases, in which the rash appeared on the day after the patients' admission to the hospital, information on this point was not obtained.

Speaking generally, an enema of either soap and water to which two or three ounces of olive oil had been added, or glycerine, was given when the bowels had not been opened for four consecutive days in the active stage of the disease, or for two consecutive days during early convalescence. In no case could the appearance of the rash be ascribed to drugs given by the mouth, nor did the rashes bear any constant relation to the severity of the attack.

One finds a difficulty in explaining their occurrence as arising directly from the administration of enemata, although many have noticed this strange association. It is probable that constipation, the symptom for which enemata are given, has more to do with the production of these rashes than the enemata. The appearance of similar rashes in connection with septic absorption in other diseases has long been recognized, and it is not difficult to conceive that if the bowels were constipated, effete products, remaining a long time in the intestine, might become absorbed by an ulcerated surface and give rise to such rashes: to find that an enema had been given is only what one might expect under such circumstances.

Petechial rashes occurred in Cases 6, 22, and 208.

In Case 6, a girl *æt.* 13, small petechial hæmorrhages appeared on the chest and abdomen on the twelfth day of a mild attack.

In Case 22, a girl *æt.* 14, who was admitted on the twenty-second day of the fever in an almost moribund condition, the patient was covered with small subcutaneous hæmorrhages, and died two days later.

In Case 208, a boy æt. 4, numerous small subcutaneous hæmorrhages appeared on the arms and face on the last day of the fever, and at the same period he passed a large quantity of blood in his urine.

Spleen.—The spleen could be easily felt below the ribs in about 40 per cent. of the cases; in many it was very large, whilst in others, even in very severe cases, increase in size could not be detected by percussion. Palpable enlargement of the spleen appeared to be more common in children than in adults.

Delirium was more frequent and more noisy in character among the first patients admitted to the hospital than among the later cases. Many of the former were howling and screaming continually. When delirium occurred in the later cases it was much less noisy.

Relapses.—Statistics on this point are always unsatisfactory to record, since so much difference of opinion exists as to what degree of development of symptoms may be held to justify the term “relapse.” The same difficulty is expressed by the medical officers of the Metropolitan Asylums Board in the Medical Supplement of the Statistical Report for 1896.

The question of relapse here has not been decided upon the presence or absence of one or more of the leading symptoms, but upon a general view of the symptoms accompanying the pyrexia, and the exclusion of local inflammatory conditions. It is possible that I have made the term “relapse” more inclusive than many who have published statistics, but all the relapses recorded here were treated as such.

Relapses occurred in 36 out of the 183 cases in Class 1. Fifteen were males and twenty-one were females. One source of fallacy must not be overlooked. Eight patients were admitted on account of relapse or relapsed after having been admitted convalescent, and ought not therefore to be included in these statistics. Excluding these, there were 28 relapsing cases out of 175 admitted, or 16 per cent.

I have arranged these 28 cases into two classes according as there was or was not present an apyrexial interval of more than two days between the primary attack and the onset of

relapse. In the first class (those in which there was a well-marked interval of apyrexia) there are 19 cases (10.9 per cent.), and of these eight were male and eleven were female; seven were children and twelve were adults.

The primary attacks preceding the relapses terminated in the following weeks of the disease:—In three cases in the third week, in six cases in the fourth week, in five cases in the fifth week, in two cases in the sixth week, in two cases in the eighth week, and in one case in the ninth week.

The days of apyrexia preceding the relapses were as follows:—Three (twice), four (twice), five (twice), six (twice), seven, eight (twice), nine (four times), eleven, thirteen, fourteen, fifteen, and twenty-four days.

The average duration of the apyrexial period in this class was nine days. The duration of the relapses in the various cases was as follows:—Five, seven, eight, ten, eleven, twelve, fourteen, fifteen (twice), seventeen, nineteen (four times), twenty, twenty-one, twenty-two, twenty-four, and twenty-eight days. Three of these cases had a second relapse, the duration of the relapses being twelve, thirteen and fourteen days respectively; and the duration of the preceding apyrexial intervals, one, two and twelve days.

In five cases, no food other than milk had been given before the onset of relapses; in four nothing more solid than Benger's Food, custard and blancmange; five cases were having bread-crumbs and milk, and the four remaining cases were taking solid food.

It is obvious that the occurrence of relapses cannot be ascribed in all cases to the too early administration of solid food, but I must here remark that in a few cases where a rather liberal diet was allowed early in convalescence slight rises of temperature frequently occurred, and were associated with a coated tongue, and these symptoms sometimes continued if the unsuitable food were not withheld.

In the second class (those in which the interval of apyrexia between the attacks was less than two days) are the remaining nine cases (5.1 per cent.). I believe many would prefer not to call these "true relapses," and would consider them as a part of

the primary attacks, but to me it is very difficult to draw such a distinction, as these rises of temperature were usually preceded by a gradual defervescence, and ran a similar course to the relapse of the first class; and it seemed, as it were, that a reinfection had taken place before the termination of the primary attack.

Three of these patients were males and six were females; three were children and six were adults. The primary attacks preceding the relapses terminated in two cases in the third week, in four in the fourth week, in two in the sixth week, and in one in the seventh week of the fever. The relapses were of the following duration:—Twelve, fourteen, nineteen, twenty-two, twenty-three, twenty-five, twenty-eight, thirty-four and thirty-eight days. In three a second relapse occurred; the duration of these second relapses was ten, fourteen and fifteen days respectively, and of the apyrexial periods preceding them, ten, fourteen and fifteen days. All the patients in this class were having no food other than milk and beef-tea.

On considering the relapsing cases collectively it will be seen that relapses were rather more common in females than in males, and, since 52 per cent. of the patients were under fifteen, the relative frequency in children and adults was about as 5:9; in several cases the relapse was more severe than the primary attack but the reverse was more usual. No patient died during a relapse. The great difference in the frequency of the occurrence of relapses as recorded by various authors must, I think, depend partly upon different interpretations of the term. Statistics given by reliable observers show a range from 3 to 18 per cent.

In Cases 77 and 116 the temperature reached 104° on the first day of the relapse (Charts I. and II.)

Under this heading I may mention two cases of interest amongst the eight relapsing cases excluded from the above statistics.

In Case 68 there was considerable doubt as to whether the attack of typhoid which occurred in the hospital was a primary attack or a relapse. In the Appendix I have discussed the possibility of the patient being infected by means of an enema-

syringe which had been used for other patients. Although the question as to the nature of the first illness cannot be definitely settled, it will serve to illustrate the importance of the greatest care being taken, when one is dealing with doubtful cases of typhoid, and when isolated cases of typhoid are being treated in the wards of general hospitals, to use separate enema-apparatus.

Anderson⁹ records two cases, occurring in a fever hospital, in which he supposes that infection was conveyed by means of an enema-syringe that had been used for typhoid patients in the same wards. He also quotes these cases as illustrating the effect of frequent doses of salol in aborting the disease on the fifteenth day, and as showing the duration of the incubation.

His first case, a child aged 3, did not come under treatment until the fourteenth day, and pyrexia subsided on the sixteenth day. For some reason, not fully set forth in his article, he did not think the child to be suffering from typhoid fever, although I imagine such was the diagnosis on which the child was admitted. An enema was administered for constipation. The second illness, undoubtedly typhoid, commenced after ten days' apyrexia.

I have already shown that in this epidemic it was not uncommon for the disease to run a short course in children, and I think one would sometimes find it exceedingly difficult to decide whether a child of 8 was or was not suffering from typhoid if the case did not come under observation until the fourteenth day of the disease.

His second case, a child aged 5, was admitted on the fourth day of the illness, and under treatment with salol, the pyrexia did not completely subside until the fifteenth day, although it was not above 100° after the eleventh day. Enemata were given for constipation. The patient was found to have pneumonia of the base of the left lung. The second illness, undoubtedly typhoid, commenced after fifteen days' apyrexia.

I conclude that Dr. Anderson thought at the time of admission that this patient's first illness was typhoid, since the child was

⁹ *Glasgow Medical Journal*, November, 1894.

treated with his salol remedy with the result that the temperature subsided to normal on the fifteenth day. Is it not, indeed, possible that the pneumonia was a complication of typhoid in the first illness, and that it obscured the original disease?

The evidence Dr. Anderson brought forward in these cases is hardly sufficient to convince one that infection took place in the manner he described; nor does the evidence in my case make a similar occurrence more than probable.

Case 107 is interesting in that the patient was admitted to the hospital at the end of a second relapse, and that he afterwards had a most severe third relapse, lasting twenty-two days, at the end of which two intestinal hæmorrhages of ten and twenty ounces respectively occurred, when the prospect of his recovery seemed almost hopeless. He, however, made a good recovery.

COMPLICATIONS AND SEQUELÆ.

Hæmorrhage.—Hæmorrhage from the bowels in quantities of more than four ounces occurred in the following ten cases (5·5 per cent.): Nos. 1, 12, 17, 19, 42, 73, 88, 95, 107, and 143, and on fifteen occasions. It took place once in the second week, six times in the third week, three times in the fourth, and twice in the sixth week of the primary attack; once on the sixteenth day of a first relapse, and again on the twentieth and twenty-second days of a third relapse.

Cases 1 and 143 terminated fatally, but in the former only was death directly due to hæmorrhage, and from the history obtained, the correctness of which I should be inclined to doubt, the hæmorrhage occurred on the tenth day of the disease. Two only of the ten patients were under the age of fifteen, showing that (52 per cent. of the patients admitted being under fifteen) severe hæmorrhage was much more common in adults than in children.

Hæmorrhage in smaller quantities only occurred in the following fifteen cases:—Nos. 4, 41, 44, 48, 67, 68, 74, 103, 109, 116, 155, 160, 167, 185 and 203; and on twenty-one occasions. It took place three times in the second week, seven times in the third week, five times in the fourth week, and

three times in the fifth week of primary attacks; once on the seventeenth day of a relapse, and again on the fifth and twenty-first days of convalescence. Cases 103 and 185 died.

There were, therefore, four deaths amongst the twenty-five patients who had hæmorrhage, giving a mortality-rate of 16 per cent., which is nearly three times the mortality-rate amongst the 183 cases here considered (5·46 per cent.) In one case death was directly due to hæmorrhage, in two perforation occurred, whilst in the fourth death was due to exhaustion.

These results closely correspond with the views Murchison¹⁰ has expressed, who regarded hæmorrhage after the twelfth day as a serious symptom, as even if there is only a slight bleeding it is often the precursor of one that is profuse. He states that the bleeding makes it probable that the ulceration has extended beneath the transverse muscular fibres, and that such ulceration is not unlikely to go on to perforation. Of 60 cases of profuse hæmorrhage which came under his notice thirty-two died; in eleven cases the immediate cause of death was peritonitis.

Osler¹¹ records twelve cases of hæmorrhage occurring amongst 160 patients under his care during two years; three proved fatal—two from peritonitis.

Periostitis.—Periostitis occurred in the nine following cases (about 5 per cent.):—Nos. 3, 47, 55, 73, 95, 99, 130, 141, and 147, and affected eleven bones. In two cases it followed slight injuries; in no case did it go on to suppuration. The respective ages of the patients were as follows:—two, nine, eleven, twelve, twelve, sixteen, seventeen, twenty-one, and twenty-five years. The tibia, radius, and ulna were each affected twice; the rib, humerus, coracoid process of scapula, clavicle, and metatarsal bone once only. This trouble arose at the following periods after the commencement of convalescence:—three, six, eight (twice), thirteen, fifteen, and seventeen days, and four, seven, and twelve weeks (twice).

Abscesses occurred in the following eight cases (4·4 per cent.):—Nos. 28, 35, 66, 101, 142, 146, 179, and 133. The ages of the

¹⁰ Murchison & Cayley, "Continued Fevers."

¹¹ Johns Hopkins Hospital Reports, Vol. V.

patients were as follows:—five, five, six, eight, eleven, sixteen, eighteen, and forty-four years. In Case 179 the abscess broke into œsophagus(?) at the end of a primary attack; in Case 35 multiple abscesses arose during a relapse, whilst in the six remaining cases they occurred within the first ten days of convalescence. In Case 28 abscesses became a serious complication. The sites of the abscesses were as follows:—The subcutaneous tissues of the arm, back, shoulders, calf of leg, front of trachea, behind mastoid process, and the ischio-rectal fossa. One arose in an inflamed lymphatic gland in the neck.

Thrombosis of veins occurred in seven cases (3·8 per cent.) The patients' ages were seventeen, twenty, twenty-three, twenty-nine, thirty-four, thirty-nine, and forty-four years, *i.e.* they were all adults. In Cases 7, 10, 33, 88, and 179 the veins of the left lower extremity were alone involved; in Case 53 the veins of both lower extremities were involved, and in Case 4 the veins of the right antecubital space. In Cases 33, 53, and 179, the thrombosis was accompanied with rigors. In three cases thrombosis set in during the fourth week of the fever; in two cases six days, and in the remaining two cases three and five weeks respectively, after the commencement of convalescence. All recovered.

Pleurisy occurred in the four following cases (2·2 per cent.) Nos. 10, 53, 68, and 179. The patients' ages were 28, 27, 98 and 44 years. In Case 10 the pleurisy occurred during the third week of the fever; in Case 53 at the end of the fourth week, and in Cases 68 and 179, on the eleventh and seventh days respectively of convalescence. A marked quantity of effusion was present in Case 53 only. In three of these cases thrombosis of veins occurred, an association which I do not remember having heard of before, although I suppose both these complications are due, in part at least, to micro-organisms or their poisonous products circulating in the blood.

The following five cases of *unusual mental disturbance* are of interest:—

In Case 107 (aged thirty-five) it was difficult to keep the patient nourished during the end of a third relapse, as he had a fixed idea that it was wicked to take food.

Case 142 (aged sixteen) had hallucinations and delusions, usually believing himself to be entering into poaching expeditions and poultry-dealing. This mental condition lasted throughout his illness, and for ten days after the termination of a slight relapse.

Case 148 (aged thirteen) was in an extremely emotional condition during the active stage of his illness and early convalescence.

Case 203 (aged thirty-five) was much depressed, and on the twenty-first day of the fever (the day before admission) attempted suicide by hanging himself.

Case 205, a patient (aged twenty-six) who was mentally deficient, gave birth to a six-and-a-half months' child during early convalescence. She was depressed throughout her illness, and had delusions. She constantly feared that some harm might overtake her.

All these patients recovered their mental equilibrium except the last-mentioned, who had almost reached her normal condition when she was discharged.

I may here mention that a woman (Case 80) who had once been an inmate of an asylum, though for what form of mental disease I do not know, was not at all mentally affected by her depressing illness.

Case 128 is also of interest in that the patient had been subject to epileptic fits since he was sixteen years old, but had had only one fit during the year previous to being admitted. He had two severe epileptic fits just as he was approaching convalescence: the bowels were constipated at this period. I mention this, as Dr. Abercrombie¹² has recorded a case where he believed convulsions during an attack of typhoid to be due to constipation.

Jaundice occurred as a sequela in Cases 2 and 108, children of three and two-and-a-half years respectively. The jaundice-tint of the skin was slight, but in both cases there was evidence of a deficiency of bile-pigments in the stools, as well as of its appearance in the urine. It caused the patients very little

¹² *Medico-Chir. Transactions*, Volume LXXX.

discomfort, and disappeared entirely in the course of a few days. Physical examination of the abdomen revealed nothing abnormal.

Peri-anal ulceration occurred at the end of the second week of the fever in Case 30.

Severe and persistent vomiting during a relapse which did not yield to treatment by drugs, and from which the patient almost collapsed, occurred in Case 19.

The front teeth became loose and threatened to fall out during the height of the fever in a third and severe relapse in Case 107.

Parotitis occurred in one case only (No. 90), and about a month after convalescence had commenced. The parotid gland never threatened to suppurate, and the patient made a good recovery.

Local Peritonitis (?). Case 173 is interesting in that the patient presented symptoms of perforation on the third day of convalescence, but, although her condition appeared very grave for several days, she made a good recovery. As the bowels had been freely moved a few hours previous to the onset of these symptoms, it is hardly likely that her condition was due to constipation (Chart III.).

A somewhat similar case is recorded by Dr. Herringham and Mr. Bowlby.¹³ A girl, æt. 13, who was passing through an attack of typhoid, had a subnormal temperature on and after the twenty-second day. On the twenty-eighth day symptoms appeared like those of perforation, viz., acute pain, frequent vomiting and small pulse, together with rigidity and tenderness of the abdomen. These symptoms came on suddenly. The bowels had been open the day before. An oil enema was administered, but neither that nor the administration of morphia gave any relief. After three-and-a-half hours it was thought advisable to perform laparotomy. No abnormal condition was found except that the colon contained scybala. Recovery was uneventful. The condition though giving rise to alarming symptoms was evidently due to constipation.

Neuritis.—Case 179 presented many symptoms of neuritis in the third week of the fever, but as these symptoms were not associated with any obvious wasting of muscles, and complete

¹³ *Lancet*, January 30th, 1897.

recovery occurred in the course of three or four weeks, it is uncertain whether there was any actual organic change in the nerves.

Tender Toes.—There was great sensitiveness of the tips of the toes in Case 127 during the third and fourth weeks of the fever. Osler,¹⁵ who has recorded many such cases, found that in most of them this symptom followed the cold-bath treatment.

Typhoid Spine.—Case 53 suffered with intense pain in the back during convalescence, and presented symptoms similar to a condition described by Gibney as “typhoid spine.” Osler¹⁵ has reported several characteristic cases, and gives a short account of this complication in the last edition of his work.¹⁶

Abortion at the second month occurred in Case 151, on the seventh day of the disease.

Premature Labour occurred in Case 205 on the tenth day of convalescence. A six-and-a-half months' child was born which lived about half-an-hour. Labour was associated with a rise of temperature to 104·6° (Chart V.).

I believe these two patients were the only pregnant women amongst the cases here referred to. Both recovered.

Vulvar irritation with superficial ulceration occurred in Case 127, causing pain on micturition. The urine contained albumen during the febrile period of the illness, but no irritating constituent was discovered.

Hæmaturia. In Case 208, æt. 4, temporary hæmaturia was associated with the appearance of numerous subcutaneous hæmorrhages on face and arms, at the end of a primary attack.

Perichondritis of the thyroid cartilage occurred in Case 127 at the end of the third week of the fever.

Mastitis.—In Case 73 the left breast became inflamed on the third day of a relapse. The patient had a child less than a year old, but had not nursed it for many weeks previous to this occurrence.

¹⁵ Johns Hopkins Hospital Reports. Vols. IV. and V.

¹⁶ Osler “Principles and Practice of Medicine.”

Corneal Ulcer.—Case 30 had a very severe attack of fever, and at the end of the third week there was slight ulceration of the right cornea.

A Syncopal Attack followed by alarming symptoms, which lasted several hours, occurred in Case 10, and was apparently brought about by the patient being rolled on to her left side, whilst the back of the chest was being examined.

Scarcely anything has been said about the condition of the heart and lungs, as it has been found impossible to treat complications of these organs statistically.

I can say nothing fresh on the subject of the various signs of heart-failure; the pulse-rate has already been considered in relation to prognosis.

Bronchitis was very common and sometimes severe; hypostatic congestion of the lungs was frequent; lobar pneumonia and broncho-pneumonia occasionally occurred during the height of the fever, but their presence was generally obscured by the disease they complicated.

As the urine was not examined systematically in every case statistics cannot be given as to the frequency of albuminuria.

Retention of urine occurred frequently, necessitating the passing of a catheter, but was only represented once amongst the fatal cases.

Rigors occurred in the following eight cases during their residence in the hospitals:—Nos. 33, 53, 61, 87, 88, 94, 172 and 179. Before discussing them, I will briefly review the various ascribed causes of this symptom in typhoid fever.

Osler,¹⁷ in an article on the subject, states that they may occur:—

(a). At the onset of the disease.

(b). At the onset of a relapse.

(c). As the result of treatment, such as the administration of modern antipyretics (*e.g.*, antipyrin), the injection of sterilized cultures of typhoid bacilli, and the application of guaiacol to the skin, &c.

¹⁷ Johns Hopkins Hospital Reports, Vol. V.

(d). With the onset of complications.

He writes: "During the height of the fever, or after convalescence has begun, a rigor may precede the development of pneumonia, pleurisy, acute otitis, suppuration in the mesenteric veins, pyæmia, abscesses of the kidneys, perforation of the ileum, or appendix, or an acute periostitis. It sometimes occurs with thrombosis of the femoral or saphenous veins. In rare cases it may precede the development of acute and fatal pyrexia. On the whole, however, rigors are rare in the complications of typhoid fever, as will be noticed in the full analysis which I have given of our cases. In thrombosis a chill may occur at the onset, or recurring rigors may be associated later with suppuration of the clot and with the development of pyæmia."

(e). Throughout the illness, when no complication is discoverable.

(f). With concurrent malaria.

Dr. Abercrombie¹⁸ has recorded instances where he ascribed rigors to constipation, and all the rigors of this kind he has met with have, with one exception, occurred in women.

Rigors have also followed mental worry.

Dr. Church¹⁹ describes the case of a girl, æt. 12, who had twenty-two rigors in fourteen days during a primary attack, twenty-five rigors in fifteen days during a first relapse, and six rigors in eleven days during a second relapse. He looked upon them as depending upon elevations of the temperature of the body and as taking the place of delirium.

Bouveret²⁰ regards chills as due to an irregular or disturbed elimination of the poison, a large volume of which thrown into the blood in a short period may cause a rigor.

With regard to the eight cases in this series:—

¹⁸ Med.-Chir. Soc. Trans., Vol. LXXX.

¹⁹ St. Bartholomew's Hospital Reports, 1896.

²⁰ Lyon Medical, 1892.

In Case 33 (Chart VI.), a young woman, æt. 20, a rigor occurred on the fifth day of thrombosis of the left femoral vein (second week of convalescence).

In Case 53 (Chart XII.), a man, æt. 39, eleven rigors occurred at intervals between the thirty-second and forty-fourth day of disease, and were associated with thrombosis of the left femoral vein and non-purulent pleuritic effusion. Bowels were much constipated during this period. Thrombosis of the right femoral vein occurred later, but there was no recurrence of the rigors.

In Case 61 (Chart VII.), a man, æt. 35, two rigors occurring on the eighteenth day of the disease were attributed to mental shock, caused by his accidentally hearing news of his wife's serious illness. The bowels were loose.

In Case 87 (Chart IX.), a young woman, æt. 19, rigors occurred in the early morning of the fourteenth and seventeenth days of the fever. This patient had most obstinate constipation throughout her illness; the bowels had not been opened for two and three days respectively before each rigor, but, as will be seen from the chart, were relieved by an enema shortly afterwards. Small doses of phenacetin were given on the eighth, ninth, eleventh, twelfth, and thirteenth days of the fever, and although it is possible that the first rigor might have been due to the administration of this drug, it is improbable that such was the cause of the second.

In Case 88 (Chart XIII.), a woman, æt. 34, several rigors occurred before her admission to the hospital (all of which were not recorded) and four more after her admission. There was obstinate constipation during the latter period requiring the frequent use of enemata, but as to the condition of her bowels before admission, I have no reliable record. The last rigor occurred shortly after two slight intestinal hæmorrhages. The left femoral vein became thrombosed during convalescence, but without a recurrence of the rigors.

In Case 94 (Chart X.), a boy, æt. 14, four rigors occurred during the first week of a severe relapse, and another after an interval

of eight days. He was admitted to the hospital with a temperature of 106.4° . The same evening $2\frac{1}{2}$ grains of phenacetin was given, and the first two rigors occurred within fifteen hours of its administration. The fourth rigor occurred eight hours after the administration of a similar dose.

No cause was found for the fifth rigor; the bowels were not constipated.

In Case 172 (Chart VIII.), a boy *æt.* 4, a rigor occurred on the tenth day of the fever which I can only attribute to constipation. The bowels had not been opened for three days before the rigor occurred, but an enema given shortly afterwards was followed by a good result.

In Case 179 (Chart XI.), a woman *æt.* 44, two rigors occurred on the second and eighth days after the onset of thrombosis of the left saphenous vein. The bowels were at the same time constipated.

The rigors were in all these cases associated with a marked rise of temperature. Cases 53, 61, 87, 88, 94, and 179 were neurotic and excitable patients; the first five of these had unusually severe attacks, and I may say that at some period of their illnesses a fatal termination was feared. All, however, recovered.

Osler, who has given in the above-mentioned article particulars of eleven cases of typhoid in which rigors were attributed to a variety of causes (not including those occurring at the onset of the disease) records only one death amongst them; and in this case a rigor preceded fatal hyperpyrexia.

It would appear, therefore, that rigors occurring after the onset of the disease are of less serious importance as regards prognosis than one might at first suppose.

Rigors were in none of my cases treated by large doses of quinine. The patient was wrapped in a warm blanket, a hot water bottle was put to the feet, and a full dose of brandy was usually administered. After the chill has passed off the temperature, if very high, was reduced by sponging, &c.

Mortality.—During the epidemic 1847 cases of typhoid fever were notified to the Medical Officer of Health of the borough;

TABLE VII.—SHOWING INCIDENCE OF COMMON COMPLICATIONS AMONGST 183 CASES.

Age.	Number of Cases.	Hæmorrhages.	Hæmorrhages (over 4 oz.)	Periostitis.	Abscesses.	Thrombosis of Veins.	Pleurisy.	Relapses Amongst 175 Cases.
Under 5 yrs.	9	—	—	1	—	—	—	1
5 to 10 "	31	3	1	1	4	—	—	2
10 to 15 "	55	3	1	3	1	—	—	7
15 to 20 "	31	6	3	2	2	1	—	8
20 to 30 "	27	5	3	2	—	3	2	7
30 to 40 "	22	6	2	—	—	2	1	2
40 to 50 "	7	2	—	—	1	1	1	1
Over 60 "	1	—	—	—	—	—	—	—
Total	183	25	10	9	8	7	4	28
Rate per cent.		13.7	5.5	5.	4.4	3.8	2.2	16.

and 132 deaths from the disease were registered during the same period. The death-rate therefore was 7·14.

To compare the mortality in this epidemic with that which occurred at Worthing in 1893, there were about 400 more persons attacked in the former than in the latter; the death-rate in the Worthing epidemic, however, was over 13 per cent., or nearly twice as great as the mortality in the Maidstone epidemic.

Of the 210 cases here recorded, 10 died; *i.e.* the mortality-rate was 4·76 per cent.; or (excluding the 27 cases in Class II. all or most of which had been notified as suffering from typhoid fever before their admission to the hospitals) the mortality-rate was 5·46 per cent.

This is a highly satisfactory result, and in considering it, due weight must be attached to the more healthy surroundings of the patients in the hospitals, and the continuous attendance on them of trained nurses. Through having telephonic communication between the various hospitals, any unfavourable symptom occurring in a patient could be immediately reported to one of the medical officers, and without great inconvenience the latter could visit the very severe cases many times a day.

Of 66 cases admitted to the hospitals on the sixth, seventh, eighth, and ninth days of the fever, seven died (=10·6 per cent.) Of the three remaining fatal cases two were admitted in the third and one in the fourth weeks of the fever.

The deaths took place on the following days of the disease: Tenth (?), fifteenth, sixteenth (four), twenty-second, twenty-fourth, twenty-seventh, and thirty-third. The respective ages of the patients were nine, ten, fourteen, fourteen, sixteen, twenty-one, thirty-three, thirty-six, forty-four, and sixty. Four died within three days of their admission.

Circumstances rendered it inadvisable to ask the friends of the deceased patients to allow autopsies to be made. It will therefore be understood that it is impossible to give a full account of the fatal cases.

Case 1 died of hæmorrhage shortly after admission, and according to the history obtained (which was not considered reliable), on the tenth day of the fever.

Case 21, a man aged sixty, died on the eighteenth day (two days after admission) of hypostatic congestion of the lungs, and exhaustion.

Case 22 was almost moribund on admission and died two days later; the body was covered with small subcutaneous hæmorrhages.

Cases 23 and 25 died of exhaustion from diarrhœa and bronchitis on the sixteenth and twenty-seventh days respectively; there was bleeding from the mouth in the former.

Case 38 died on the third day after admission, and on the fifteenth day of the disease, from exhaustion following wild delirium and profuse diarrhœa. There were indefinite signs of early pneumonia.

Case 103 died on the twenty-second day; there were indefinite signs of early pneumonia and perforation. Hæmorrhage, severe diarrhœa, and tympanites occurred in this case.

Cases 143 and 185 died with symptoms of perforation and peritonitis on the sixteenth day of the fever. Hæmorrhage occurred in both these cases.

Case 184 died on the thirty-third day of exhaustion from profuse and long-continued diarrhœa and pneumonia.

Sero-diagnosis. — Dr. H. E. Durham made a series of observations on the precipitating (or “clumping”) properties of the sera obtained from sixteen of my cases, and has already published some results of his experiments.²¹ He has very kindly allowed me to make use of his notes, and Table VIII. gives a concise account of some of the results he obtained. He writes: “The method employed was practically that of Professor Wright, of Netley, specimens of different dilution being made in capillary tubes. Having controlled the results given in many parallel observations made by this method with those given by the microscope alone, I venture to assert that this method is by far the most valuable that we are in possession of; and on the whole leads to less equivocal results—that is to say, when the criterion of measurement of potency is the ultimate dilution

²¹ *Lancet*, January 15th, 1898.

TABLE VIII.—SHOWING REACTION OF SERA.

No. of Series.	No. of Case in Appendix.	Date of Collection.	Period of Disease.	Highest dilution giving positive reaction.		Remarks.
				Erberth Culture.	Gärtner Culture.	
1	88	Oct. 30, 1897 ...	52nd day	1 : 10,000	1 : 100 (1 : 200 = slight)	Very severe attack associated with frequent rigors and followed by thrombosis of veins.
2	48	Oct. 30, 1897 ...	7th day of relapse	1 : 1000	1 : 500	Very severe primary attack lasting 38 days.
3	77	Oct. 30, 1897 ...	14th day of relapse	1 : 1000	1 : 100	Very severe relapse; primary attack lasted 16 days.
4	89	Oct. 30, 1897 ...	17th day	(1 : 100 = 0) ...	... ..	No sign of typhoid after admission, and from the history it was thought not to be typhoid.
5	91	Oct. 30, 1897 ...	? 32nd day ...	(1 : 20 = 0) ...	... ..	As No. 4.
6	16	Oct. 30, 1897 ...	44th day	1 : 500	1 : 100	Very severe primary attack followed by mild relapse.

TABLE VIII.—SHOWING REACTION OF SERA—continued.

No. of Series.	No. of Case in Appendix.	Date of Collection.	Period of Disease.	Highest dilution giving positive reaction.		Remarks.
				Erberth Culture.	Gärtner Culture.	
7	28	Oct. 30, 1897 ...	26th day of convalescence	(1 : 20 = ? trace)	... ..	Disease ran a rather severe course of 26 days and was followed by severe abscesses.
8	142	Nov. 21, 1897 ...	5th day of convalescence	1 : 200 (1 : 500 = slight)	(1 : 100 = trace)	<i>Pus serum</i> . Severe attack with slight relapse. Abscess in neck.
9	101	Nov. 20, 1897 ...	13th day of convalescence	(1 : 100 = 0) ...	... ..	<i>Pus serum</i> . A mild attack lasting 12 days, almost certainly typhoid, followed by acute abscess in calf; pus contained streptococci.
10	33	Nov. 28, 1897 ...	41st day of convalescence	1 : 1000	1 : 200	Moderately severe attack lasting 23 days, followed by thrombosis of veins.
11	98	Nov. 28, 1897 ...	28th day	1 : 1000	1 : 100	Moderately severe attack with two relapses.

TABLE VIII.—SHOWING REACTION OF SERA—continued.

No. of Series.	No. of Case in Appendix.	Date of Collection.	Period of Disease.	Highest dilution giving positive reaction.		Remarks.
				Erberth Culture.	Gärtner Culture.	
12	109	(i.) Nov. 29, 1897 (ii.) Jan. 6, 1898	27th day 27th day of convalescence	(1 : 100 = ? trace) 1 : 100 (1 : 200 = slight)	... .. ... .. (1 : 20 = trace)	Moderately severe attack lasting 39 days.
13	105	(i.) Nov. 28, 1897 (ii.) Jan. 6, 1898	34th day 28th day of convalescence	1 : 200 (1 : 500 = slight) (1 : 20 = trace)	1 : 100 (1 : 20 = trace)	Rather severe attack ; duration 45 days.
14	114	Nov. 28, 1897 ...	Convalescence	(1 : 100 = 0) ...	(1 : 100 = trace)	As No. 4. Illness probably due to chronic alcoholism.
15	97	Nov. 30, 1897 ...	Convalescence	(1 : 20 = 0) ...	... ..	As No. 4.
16	68	(i.) Nov. 28, 1897 (ii.) Jan. 7, 1898	33rd day 40th day of convalescence	1 : 100 1 : 20	(1 : 100 = 0) ... (1 : 20 = 0)	Convalescent when admitted. Second illness (? primary attack, ? relapse) rather severe and lasted 33 days.

in which the reaction can be detected—and for the purposes of testing human sera this is the best criterion.”

From Dr. Durham's results it will be seen that the sera of Nos. 1, 2, 3, 6, 8, 10, 11, 12, 13 and 16, all of which cases undoubtedly had typhoid, gave a positive reaction with an Erberth culture.

In Nos. 1, 2, 3, 6, 10 and 11, all of which were rather severe or unusually severe cases, the sera gave a positive reaction with the highest dilution used.

In No. 1, a very severe case, a positive reaction was obtained when the serum was diluted 10,000 times.

In all the cases in which the serum when diluted at least 1:200 gave a positive reaction with an Erberth culture, it also gave a positive reaction with a Gärtner culture, though only with a lower dilution.

No. 7 gave only a doubtful trace of reaction (1:20), but in this case the serum was not collected until the fourth week of convalescence.

It will be seen that in Nos. 13 and 16, where second observations were made late in convalescence, positive reactions in the later observations were only obtained by much lower dilutions than in the earlier ones; and is it not probable that the serum of No. 7 had lost its potency through lapse of time as in these two cases?

In No. 9, an observation was made with pus-serum collected from an abscess opened on the thirteenth day of convalescence. The patient was thought to have had a mild attack of typhoid. The negative reaction may here again have been due to lapse of time, or to the mildness of the attack. A lower dilution than in 1:100 was not used.

In No. 12, a parallel case to No. 13 as regards the two periods of observation, the serum had apparently gained in potency on the second observation.

Nos. 4, 5, 14 and 15 presented no symptoms of typhoid after admission, and the previous history of their illness did not support the correctness of such a diagnosis. The observations were made with a view to confirming our conclusions.

Dr. Durham bacteriologically examined the pus from abscesses occurring in the following three cases :—

Case 66. Small abscess in front of trachea opened November 2nd (second week of convalescence). Pus examined November 14th.

Microscopically :—Abundant cocci ; some (?) bacilli.

Cultures. Agar :—Abundant staphylococcus aureus.

Broth :—Chains of four and groups of cocci ; a few bacilli.

Gelatine Plates :—Staphylococcus aureus.

Sedimentation with typhoid serum :—Staphylococcus aureus.

No *B. typhi* could be isolated although many cultures were made.

If the bacilli seen were *B. typhi* for some reason they refused to appear in the plates.

Case 101. An acute abscess opened on November 20th (second week of convalescence).

A pure culture of streptococcus was obtained from the pus.

Pus-serum gave negative reaction with Erberth culture.

Case 142. An abscess in the neck arising in an inflamed gland during an attack of typhoid ; ? tuberculous.

Cultivation :—No pyogenic bacteria.

Pus-serum gave positive reaction with Erberth culture.

Treatment.—I will say only a few words about the medical treatment of the cases, for we cannot claim to have introduced any new methods, and the treatment resolved itself chiefly into dealing with unfavourable and uncomfortable symptoms.

Great attention was paid to the ventilation of the wards, this being particularly necessary since we had to make the most of the floor-space at our command by getting as many beds as possible into each building.

Disinfectants were freely used, but it was impossible to always allow the stools to remain in contact with disinfectant for some time before being thrown away ; and much reliance, therefore, had to be placed in the thorough flushing of the w.c.'s to prevent spread of infection to attendants.

All soiled linen was immediately put into tanks containing a disinfectant, and was despatched to a laundry, erected by the Sanitary Authority, once or twice daily.

The patients, except those who were *in extremis*, were allowed to be visited by their friends for a quarter of an hour only twice a week; thereby ensuring the minimum amount of excitement to the patients.

Each nurse had on an average five or six patients to attend to, either by night or by day.

It is a matter for congratulation that not one of the nurses attending on these 210 patients contracted the disease.

As a rule the patients' diet was restricted to milk with, in some cases, meat and chicken broths, until ten to fourteen days after the temperature had become normal. Occasionally this rule was somewhat relaxed, and the first addition to the diet was usually "Benger's Food" or custard.

Several consignments of "humanized" and "sterilized" milk were sent to us for trial by the Aylesbury Dairy Company, and I cannot speak too highly of their usefulness. Patients who did not take fresh cow's milk well often retained either of these preparations, but especially the former; they found it much more palatable. These preparations were also useful in treating cases of severe diarrhœa, associated with much undigested curd in the stools. Peptonized milk was often used under similar circumstances, but although it usually agreed well, it was not so pleasant to take. If more than four liquid stools were passed in twenty-four hours, an enema consisting of two ounces of mucilage of starch with 15 to 30 minims of Tr. Opii was usually given.

Alcoholic stimulants were given when their use was indicated in the form of brandy and whisky, and in quantities varying from one to twelve ounces per diem. Champagne was much enjoyed by several patients.

Other cardiac stimulants, such as digitalis, carbonate of ammonia, and strychnine (the last hypodermically) were also used, often with very satisfactory results. Inhalations of oxygen gave relief in several cases where there was much respiratory embarrassment and cyanosis.

With regard to dealing with pyrexia, it will be readily understood that it was practically impossible to carry out the much advocated treatment by cold baths, and indeed, if such had been possible, I do not think we could have hoped for much better results.

When the hospitals were first opened the nurses were directed to sponge every patient with cold or tepid water whenever the thermometer registered $103\cdot5^{\circ}$, and to attend to adults in this respect before children, as it has long been recognised that high temperatures are more harmful in the former than in the latter. Later, when time permitted, patients were often sponged before their temperature reached this point.

In a few cases the sponging was not persisted in if patients showed intense dislike to the operation, as (in Case 87 for instance, Chart IX.) the temperature was occasionally found to be higher afterwards. One could then only conclude that such hydropathic treatment was doing more harm than good.

Antipyretic drugs, such as antipyrin and phenacetin were occasionally given to reduce the body-temperature, and were also found most useful in relieving severe headache in the early stages of the disease, which was often associated with a high temperature. Rigors followed the use of phenacetin in two cases, but it was by no means certain that they were due to the administration of the drug.

It would be quite useless for me to give details of the treatment of all the various symptoms and complications; to do such would only be repeating, to a great extent, what one would read in a text-book dealing with the subject.

My experience in this epidemic has led me to the conclusion that in dealing with cases of typhoid fever every effort should be made to avoid disturbance of the patient's peace of mind and rest of body, and that, in considering what treatment should be adopted in any particular case, this aim should never be lost sight of, and that no more frequent physical examinations than are *absolutely* necessary to guide one in the treatment of the case should, on any account, be made.

If a case was uncomplicated, and presented no unfavourable symptoms, no medicinal treatment was prescribed, and the treatment of the case resolved itself into careful nursing and proper feeding.

We were not enterprising enough to systematically test the action of many new and much recommended remedies that were sent to us for trial, and had we done so it is obvious that, with the same results, such would have been unduly credited with special virtues.

I must here express my great indebtedness to Mr. M. A. Adams, for having given me permission to publish this paper in the Reports, and for many acts of kindness and assistance in my official work; to Mr. Percy Adams, Deputy Medical Officer of Health, for similar assistance; to Messrs. Cardin and Gardiner, who assisted me in the treatment of the cases, for their clinical notes; and to Dr. H. E. Durham, for allowing me to publish the results of his bacteriological work in connection with several cases.

APPENDIX OF CASES.

CASE 1.—E. M., æt. 16, female, admitted September 25th (seventh day of illness). On admission, temperature 101° ; her condition was not such as to give cause for anxiety. On September 26th, highest temperature 103° ; bowels acted once during the day. September 27th, 6 a.m., temperature 100.8° , pulse 124; at 6 p.m., temperature 102.8° . During the evening patient vomited twice, and looked very pale. A little later she became almost unconscious. On September 28th, at 1 a.m., she passed six ounces of blood from the bowel, was very restless and throwing her arms about. At 2.30 a.m. she passed a large quantity of blood and became still more restless. Pil. Plumbi c. Opio. was given, and a hypodermic injection of morphia. Patient rapidly sank and died at 9 a.m. (tenth day of the fever).

CASE 2.—L. W., æt. 3, male, admitted September 25th (seventh day of illness). Disease ran a mild course; duration of pyrexia seventeen days; highest temperature 103.6° ; slight diarrhoea; delirium during the second week. *Sequela*.—On the seventeenth day of illness—the day on which the temperature became normal—slight jaundice appeared; at the same time the stools were clay-coloured, and urine was bile-stained. A cold water enema was administered every morning, and the jaundice disappeared at the end of a week. Discharged November 17th.

CASE 3.—A. P., æt. 25, female, admitted September 25th (fourteenth day of illness). Duration of pyrexia thirty-seven days. Highest temperature 103.4° . Roseola present. Bowels rather constipated. There was slight periostitis at the upper end of the right tibia, six days after temperature had become normal, giving rise to pain and a little thickening of the bone, but the temperature was not raised. The disease ran a mild course. Discharged November 17th.

CASE 4.—M. A. H., æt. 29, female, admitted September 25th (twelfth day of illness). Highest temperature 105° . Primary attack was most severe and lasted twenty-five days. It was accompanied with a most profuse roseola, tympanites, frequent vomiting, severe bronchitis, delirium and diarrhoea. There was slight hæmorrhage from the bowel on the sixteenth day. On the twenty-fourth day of illness, veins of ante-cubital space of right arm became thrombosed, giving rise to local pain and swelling of the forearm. On the twenty-fifth day, after a few hours' apyrexia, temperature again commenced to rise in a step-like manner, and a few days later a fresh crop of spots appeared. This relapse was less severe than the first attack, and was accompanied with constipation. It ended by crisis on the fourteenth day. The son of this patient, whose illness commenced eight days later, was admitted into the hospital (Case 34) and had a mild attack. Discharged December 8th.

CASE 5.—E. C., æt. 23, female, admitted September 25th (third day of illness). The primary attack ran a moderately severe course of twenty-five

days. Highest temperature $104^{\circ}2'$. There was diarrhœa and tympanites during the second week, and a little bronchitis almost throughout the illness. An abundant crop of spots. After six days' apyrexia, a relapse commenced lasting twenty days; it was less severe than the primary attack. A few days before the termination of the relapse an erythematous rash appeared on the dorsum of both wrists and neck. It was exceedingly irritable. An enema saponis had been given on the day previous to its appearance. Discharged December 18th.

CASE 6.—E. M., æt. 13, female, admitted September 25th (eleventh day of illness). The disease ran a rather mild course of twenty-seven days. Highest temperature $103^{\circ}6'$. Slight diarrhœa, bronchitis and delirium during the first few days of her stay in hospital. Roseola present. Five weeks after convalescence had commenced, there was a rise of temperature, lasting a few days; no cause was found for this occurrence; it was probably not a relapse. On September 26th numerous small petechial hemorrhages appeared on chest and abdomen. Discharged December 9th.

CASE 7.—L. L., æt. 17, male, admitted September 25th (fourteenth day of illness). Disease ran a moderately severe course of twenty-nine days. Highest temperature $105^{\circ}2'$. Slight diarrhœa and bronchitis; roseola present, and spleen palpable. Twenty days after convalescence had commenced, thrombosis of veins of left thigh set in, with rise of temperature, feeling of chilliness, pain and tenderness along the course of the femoral vein, and swelling of the leg. This much delayed his discharge from the hospital. Complete rest was insisted on for nearly two months, and patient made a good recovery. Discharged December 30th.

CASE 8.—G. D., æt. 13, male, admitted September 25th (seventh day of illness). Disease ran a very severe course of twenty-two days. Highest temperature $104^{\circ}8'$. Severe diarrhœa, bronchitis, and delirium; rapid and feeble pulse. On admission, there was a very unhealthy wound on buttock. This arose through the patient falling on a fender on the day previous to admission, having got out of bed in his delirium. It was impossible to keep this wound dry, as he frequently passed his evacuations involuntarily, these coming in contact with the wound. Twenty-seven days after convalescence had commenced there was a rise of temperature for several days, once reaching as high as $103^{\circ}8'$. There was no recurrence of the symptoms of typhoid; breath was foul, and tongue covered with a brown fur. The pyrexia probably arose from constipation. He made a good recovery and was discharged on January 1st, 1898.

CASE 9.—A. C., æt. 12, male, admitted September 25th (fifteenth day of illness). Disease ran a moderately severe course of thirty-one days. Highest temperature $101^{\circ}8'$. Mouth in a very foul condition on admission; bowels constipated; much delirium during the first few days in the hospital. A copious erythematous rash appeared on legs, arms, and abdomen on September 26th. It consisted of pink circles about the size of a threepenny-piece, with a central darker area. The face was purplish red, and the skin appeared to be œdematous, with the exception of the eyelids and lips. The rash was followed by desquamation. Good recovery. Discharged November 13th.

CASE 10.—A. B., æt. 23, female, admitted September 25th (eleventh day of illness). Disease ran a severe course of thirty-one days. Highest temperature $103^{\circ}8'$; delirium at the end of the second week of illness; diarrhœa

during the third and fourth weeks. On September 30th (sixteenth day), at noon, syncope occurred when patient was being rolled on to her left side for examination of bases of lungs. She became pale and lost consciousness for a few minutes. Back and limbs were rigid, eyes were fixed and pupils dilated. Temperature 97.8° ; pulse scarcely perceptible at the wrist, and slow. Between 3.30 and 8 p.m. patient was sick several times; pulse was rapid and feeble. It was at first thought that hæmorrhage was going on, or that perforation had taken place. Small doses of *Tr. Opii* were given frequently, and an ice-bag was applied to the abdomen. Late the same evening, the bowels were relieved, and the stool contained no blood. On the following day she complained of a little pain in the abdomen to the right of umbilicus; there was no rigidity of the abdominal wall. Vomiting had ceased. Breathing was rapid and shallow, and pulse was still frequent and feeble. On October 2nd, patient was shivering from time to time; abdomen full; Cheyne-Stokes breathing. A few days later a pleuritic rub was heard in right axilla. There were signs of hypostatic congestion at bases of both lungs. She made a rapid recovery and was sent to a convalescent home on November 17th. Unfortunately, however, on the day after her departure the veins of the left lower extremity became thrombosed. This occurred about five weeks after the temperature had become normal.

CASE 11.—M. B., æt. 17, female, admitted September 25th (fifteenth day of illness). Disease ran a mild course of nineteen days. Highest temperature 103° ; bowels constipated; no delirium. Good recovery. Discharged November 17th.

CASE 12.—M. D., æt. 7, female, admitted September 25th (fourteenth day of illness). A moderately severe case. Duration of pyrexial period, thirty-seven days. Highest temperature 104.2° ; bowels constipated; delirium during the third week. On the twenty-first day, about 4 ounces of blood was passed from the bowel. She made a good recovery, and was discharged on November 27th.

CASE 13.—F. I., æt. 10, female, admitted September 25th (ninth day of illness). Disease ran a rather mild course of twenty-one days. Highest temperature 104.8° ; roseola present; spleen not palpable. Good recovery. Discharged November 17th.

CASE 14.—C. O., æt. 14, male, admitted September 25th (eighth day of illness). Disease ran a severe course of eighteen days. On admission, he was much emaciated and the teeth were covered with sordes. He was extremely delirious during the first week of stay in hospital, and had severe bronchitis and hypostatic congestion of lungs. Highest temperature 105.4° . He made a good recovery and was discharged on November 13th.

CASE 15.—F. A., æt. 11, male, admitted September 25th (ninth day of illness). Primary attack ran a mild course of twenty-five days. Highest temperature 103.2° ; bowels constipated; roseola present; spleen palpable. A little delirium during the second week. After the temperature had been normal a few hours only, it again began to rise in a step-like manner, becoming normal on the twelfth day. This relapse was milder than the primary attack. He made a very good recovery and was discharged on November 27th. His brother, who was attacked on the same day, was also admitted to the hospital (Case 16). He had a long and severe illness.

CASE 16.—A. A., æt. 13, male, admitted September 25th (ninth day of illness). A long and severe attack, followed by a mild relapse. Duration of primary attack fifty-three days. Highest temperature 104.4° ; roseola present; bowels constipated except during the second week of his illness when he passed his evacuations under him; rather severe bronchitis. Temperature was not above 100.2° on thirtieth, thirty-first, and thirty-second days; afterwards it rose reaching 103° on the forty-sixth day, and fell to normal on the fifty-third day. After seven days of apyrexia a relapse commenced lasting seven days; highest temperature 101.6° on the fourth day; bowels continued constipated, and tongue became more furred. He made a good recovery and was discharged on January 3rd.

CASE 17.—M. H., æt. 15, female, admitted September 25th (fourteenth day of illness). Primary attack ran a severe course of twenty-seven days. Much noisy delirium; profuse diarrhœa; roseola present. On the twenty-third day of first attack about an ounce of blood was passed from the bowel; and on the twenty-fifth day about eight ounces. After four days' apyrexia, temperature again rose until it reached 104.8° on the twelfth day. A fresh crop of spots appeared. There was a recurrence of hæmorrhage on the fifteenth and sixteenth days of this relapse; on the former day she passed two ounces of blood, and on the latter day eight ounces. The relapse was almost as severe as the primary attack. A small bed-sore developed over the sacrum. During her illness patient lay with her legs drawn up in the bed, in consequence of which the hamstring muscles became contracted. The legs were frequently straightened forcibly. She made a slow but good recovery. When discharged on January 22nd the right knee-joint remained slightly flexed, and the resistance of the hamstring muscles could not be overcome by ordinary force. She could walk well. Her sister, who was attacked eight days later, and was also admitted to the hospital, had a severe attack, with much delirium.

CASE 18.—A. B., æt. 18, female, admitted September 26th (eighth day of illness). She had a rather severe attack, lasting twenty-two days. Highest temperature 104.8° . Diarrhœa during the second and third weeks; spleen palpable. Patient menstruated during the second week. Good recovery. Discharged November 22nd.

CASE 19.—F. C., æt. 21, female, admitted September 26th (sixteenth day of illness). Primary attack ran a severe course of thirty-five days. Highest temperature 104° . Diarrhœa during the third week; occasional vomiting; roseola present. On the twenty-third day of disease she passed about a pint of blood from the bowel. After nine days' apyrexia a most severe relapse set in, lasting twenty-two days. During almost the whole of this period there was most persistent and uncontrollable vomiting. She became extremely emaciated and almost collapsed; no drug appeared to give any relief, and rectal feeding was resorted to for three weeks with great success. The vomit consisted chiefly of mucus. She made a good recovery, and was discharged on January 1st.

CASE 20.—P. E., æt. 15, male, admitted September 26th (fourteenth day of illness). He had a moderately severe attack, lasting twenty-six days. Highest temperature 104.4° . Roseola present; delirium during the third week; a little diarrhœa at the end of the third week. Mouth in a very foul condition on admission. Good recovery. Discharged November 13th.

CASE 21.—C. S. æt. 60, male, admitted September 26th (fourteenth day of illness). A very severe case, almost moribund on admission. Highest temperature 104° . Bowels constipated; hypostatic pneumonia. He died about thirty-six hours after admission, of asthenia and hypostatic pneumonia (sixteenth day of disease). His son was also in hospital (Case 47).

CASE 22.—A. C., æt. 14, female, admitted September 26th (twenty-second day of illness). Another case almost moribund on admission; pulse 148, small and running; respirations 40; severe bronchitis; retching; body was covered with small subcutaneous hæmorrhages. Patient died on the morning of September 28th (twenty-fourth day of illness) of asthenia and bronchitis. Her sister was also in hospital (Case 19).

CASE 23.—F. S., æt. 10, male, admitted September 26th (seventh day of illness). A severe case from the first. Highest temperature 104.8° . Bleeding from the gums and mouth; bowels loose; towards the end he passed his evacuations in the bed; there was much bronchitis; during the last few days of his illness he lay in a restless and semi-comatose condition; much cyanosis. He died on October 5th (sixteenth day) of asthenia and bronchitis. Brother (Case 24) had a mild attack. His sister (Case 42) had a very severe attack.

CASE 24.—H. S., æt. 11, male, admitted September 26th (sixth day of illness). Disease ran a mild course of seventeen days. Highest temperature 102.4° . Bowels constipated. Good recovery. Discharged November 13th.

CASE 25.—A. F., æt. 14, female, admitted September 27th (nineteenth day of illness). Extremely delirious on admission. Highest temperature 104.6° ; roseola present; severe bronchitis. During the last week of her illness she passed her evacuations unconsciously in the bed. She became more cyanosed, pulse got more rapid, and she died on October 5th (twenty-seventh day), at 1 p.m., of bronchitis and asthenia. Her sister (Case 27) also had a severe attack.

CASE 26.—E. A., æt. 16, female, admitted September 27th (thirteenth day of illness). Disease ran a mild course of twenty-five days. Highest temperature 102.4° ; roseola present; diarrhœa at the end of the third week. Good recovery. Discharged November 22nd.

CASE 27.—F. F., æt. 14, female, admitted September 27th (twelfth day of illness). A severe case, running a course of twenty-six days. Highest temperature 104.6° ; roseola profuse; much delirium; severe diarrhœa during the end of the second, and the early part of the third weeks. Melæna, probably due to profuse epistaxis, at the commencement of third week. Severe bronchitis. She made a good recovery and was discharged on November 13th.

CASE 28.—C. C., æt. 10, male, admitted September 27th (nineteenth day of illness). This patient was much emaciated on admission, and it was said that he had always been delicate. Duration of pyrexia due to typhoid twenty-six days; delirium at first, and as convalescence approached, much irritability. Early in October there was free desquamation all over the body and limbs; the epidermis was detached in large flakes. This was shortly afterwards followed by numerous large subcutaneous abscesses in arms, forearms, shoulder and back. These abscesses formed so rapidly, and the skin of left forearm was so much undermined with pus, that we feared he would lose the limb. The abscesses were opened under an anæsthetic on

October 11th, after which the temperature gradually subsided, and he made a good recovery. Discharged December 8th.

CASE 29.—M. M., æt. 25, female, admitted September 27th (eighth day of illness). Disease ran a moderately severe course of twenty days. Highest temperature 104.4° ; roseola present; diarrhœa during the second and third weeks. No complications. Good recovery. Discharged November 17th.

CASE 30.—F. L. F., æt. 10, female, admitted September 27th (tenth day of illness). On admission there was a most foul discharge from the mouth; the teeth were covered with sordes; and she was in a neglected condition. Disease ran a severe course of thirty days. Highest temperature 104° ; during the earlier part of her stay in hospital, she lay in a semi-comatose condition; roseola present; a little diarrhœa. On September 29th, my attention was called to the condition of the nates, when I found a rather large superficial ulcer to the right of the anus; it was in a most unhealthy condition, and was covered with a slough which could not be easily separated. It gave rise to much pain on defæcation. Hot boracic acid fomentations were applied frequently, and it soon healed. On October 1st, the voice was noticed to be nasal in character. On examination of the fauces, both tonsils were found to be enlarged but no membrane could be seen. Palate was insensitive to touch. Food was not regurgitated through the nose during deglutition. Knee-jerks were present. Slight ulceration of the right cornea at the end of the third week of fever. There was a rise of temperature for four days, a fortnight after it had previously reached normal. This was probably not a relapse. After she had been removed to a transfer-hospital she was attacked with membranous tonsillitis—undoubtedly diphtheria. She made a good recovery, and was discharged on January 31st.

CASE 31.—E. A. C., æt. 30, female, admitted September 28th (eighth day of illness). A moderately severe attack of twenty-three days' duration. Highest temperature 103.6° ; bowels rather constipated; there was retention of urine, necessitating the frequent use of the catheter, during the first few days of her stay in hospital. Good recovery. Discharged December 13th.

CASE 32.—W. H., æt. 33, male, admitted September 28th (twelfth day of illness). Disease ran a moderately severe course of twenty-five days. Highest temperature 103° ; spleen enlarged; cough very troublesome during the third week owing to a little bronchitis; diarrhœa throughout his stay in the hospital. Good recovery. Discharged November 13th.

CASE 33.—F. M., æt. 20, female, admitted September 28th (fifteenth day of illness). A moderately severe case, lasting twenty-three days. Highest temperature 103.6° ; diarrhœa during the third week. On October 12th (six days after convalescence had commenced) temperature again began to rise, and a little later she complained of pain in left thigh. The left femoral vein was found to be thrombosed, and there was much tenderness along the course of the vein. The leg and foot became swollen. On the morning of the fifth day of this complication patient had a rigor, and temperature rose to 104.8° (Chart VI.). She kept her bed for six or seven weeks, and was sent to a convalescent home on December 18th; the swelling continued for some time after she was discharged.

CASE 34.—C. H., æt. 11, male, admitted October 1st (tenth day of illness). Disease ran a mild course of twenty days. Highest temperature 103.6° ; roseola present; bowels constipated. Good recovery. Discharged November 13th.

CASE 35.—F. F., æt. 18, male, admitted October 1st (seventeenth day of illness). Primary attack was severe; duration twenty-five days. Highest temperature 104° ; roseola present; severe diarrhœa until October 7th, rapid feeble pulse, delirium and bronchitis; patient several times became much cyanosed. He was frequently sponged with tepid water to reduce the temperature. Early in October several abscesses appeared on left shoulder and back. They were opened on October 6th, without an anæsthetic. After the temperature had been normal less than twenty-four hours, it again began to rise in a step-like manner. This relapse was not so severe as the first attack and lasted twenty-two days. He made a good recovery, and was discharged on January 3rd.

CASE 36.—J. B., æt. 7, male, admitted October 1st (twelfth day of illness). A moderately severe attack running a course of twenty-three days; roseola not observed; spleen much enlarged; bowels constipated; a little delirium. Highest temperature 104.8° . After temperature had been normal fifteen days, it was again raised for eleven days; the highest point reached was 101.2° ; no roseola appeared, but the spleen increased in size. This was in all probability a relapse. He made a good recovery, and was discharged on January 3rd. The next case is that of his brother, who had a severe attack; another brother who was taken in later (Case 184) died.

CASE 37.—W. B., æt. 14, male, admitted October 1st (twelfth day of illness). A severe case but uncomplicated. Duration of primary attack twenty days; diarrhœa; spleen enlarged; much delirium. Highest temperature 105° . After two days' apyrexia temperature again rose and became normal again on the nineteenth day; and after twelve days' interval a second relapse occurred lasting fourteen days. Both these relapses were milder than the primary attack. He made a good recovery, and was discharged on January 3rd.

CASE 38.—J. C., æt. 36, male, admitted October 1st (ninth day of illness). Patient had been very ill for a week before admission, and was so delirious that there was great difficulty in keeping him in bed. On admission, temperature 104° , diarrhœa and tympanites; he was constantly trying to get out of bed. On the following day he passed his evacuations under him. On the morning of October 3rd he refused food, and from this time it was very difficult to get him to take any nourishment. The tympanites had increased, and bowels were very loose; pulse 140; respirations 48. In the evening, crepitations were heard at the base of the right lung behind, and in the axilla. There was no tubular breathing; these signs were thought to indicate early pneumonia. Stimulants were freely given, and tympanites was treated with turpentine stupes applied to the abdomen, and turpentine capsules. He vomited several times during the following night, and continued very restless. The pulse got more rapid, and he died at 4.40 a.m., October 4th (twelfth day of disease).

CASE 39.—A. T., æt. 12, male, admitted October 1st (ninth day of illness). A mild case running a course of nineteen days. Highest temperature 104° ; roseola present; bowels slightly constipated. Good recovery. Discharged November 13th.

CASE 40.—E. W., æt. 24, male, admitted October 1st (fourteenth day of illness). A mild and uncomplicated case; duration twenty-one days. Highest temperature 103.4° ; bowels constipated. Good recovery. Discharged November 13th.

CASE 41.—A. G., æt. 14, female, admitted October 1st (sixth day of disease). A very mild case; duration eleven days. Highest temperature 101.8° ; bowels constipated. Five days after temperature had reached normal, and when patient was apparently convalescent, about one ounce of blood was passed from the bowel. She had a slow pulse during convalescence. Good recovery. Discharged November 13th.

CASE 42.—E. S., æt. 15, female, admitted October 1st (seventh day of disease). Primary attack very severe; duration thirty days. Highest temperature 105° ; profuse roseola; diarrhœa; bleeding from the mouth; much delirium; bronchitis. After six days' apyrexia a relapse set in, which was more severe than the primary attack, and all the previous symptoms recurred. There was a continuously high temperature during the first fortnight. A small bed sore developed over sacrum. The relapse lasted twenty-four days. Hæmorrhages occurred on four days. During the primary attack on the sixteenth day, at 1.30 p.m., a slight hæmorrhage, and at 10 p.m. about 5 ounces of blood was passed: the latter was followed by a fall of temperature. During the relapse, on the eighth day 2 ounces, on the ninth day 2 ounces, and on the twelfth day one ounce of blood was passed. She made a very good recovery and was discharged on January 3rd.

CASE 43.—A. R., æt. 15, female, admitted October 1st (tenth day of illness). A mild and uncomplicated case. Highest temperature 104.4° . Duration of disease twenty-three days; bowels constipated. Good recovery. Discharged November 20th.

CASE 44.—R. T., æt. 30, female, admitted October 1st (fifteenth day of illness). A rather mild attack; duration twenty-six days; bowels constipated. Highest temperature 103.2° ; hæmorrhage on the day previous to admission. She complained of the calves of her legs being painful after she left the hospital, but there was no evidence of neuritis. Discharged November 7th.

CASE 45.—A. F., æt. 13, female, admitted October 1st (eleventh day of illness). Disease ran a mild course of twenty-one days. Highest temperature 103.4° ; bowels constipated; a little diarrhœa at the commencement of convalescence. Good recovery. Discharged November 13th. Brother in the hospital (Case 35.)

CASE 46.—C. O., æt. 14, female, admitted October 1st (eighth day of illness). Moderately severe attack; duration twenty-one days. Highest temperature 104.4° ; a little diarrhœa during the third week. Good recovery. Discharged November 20th. Brother in hospital (Case 14).

CASE 47.—S. S., æt. 12, male, admitted October 2nd (seventh day of illness). A rather mild case; duration twenty-seven days. Highest temperature 104° ; roseola present; bowels constipated. Eight days after the temperature became normal, slight periostitis of the back of the shaft of the left ulna occurred; it was unaccompanied by rise of temperature, and never threatened to suppurate; it left a little thickening of the bone. The tongue remained furred for a long time after the commencement of convalescence, and there were occasional slight rises of temperature. Discharged December 14th. His father (Case 21) died in the hospital.

CASE 48.—L. B., æt. 19, female, admitted October 2nd (eighteenth day of illness). A very severe case; duration of primary attack thirty-eight days. Highest temperature 105.2° ; roseola present; bowels constipated; much delirium; bronchitis and hypostatic congestion of lungs; frequent small

hæmorrhages on the eighteenth, nineteenth and twentieth days of the fever. After less than twenty-four hours' apyrexia, the temperature again rose in a step-like manner; this relapse was less severe than the primary attack and lasted twenty-eight days; it was accompanied by a recurrence of the previous symptoms. Good recovery. Discharged January 12th. Her brother (Case 52) and her sister (Case 167) were also treated in the hospitals.

CASE 49.—M. C., æt. 18, female, admitted October 2nd (thirteenth day of illness). A mild attack though rather a long one; duration thirty-nine days; a little diarrhœa during the third and fourth weeks. Highest temperature 104.2°. Good recovery. Discharged December 11th.

CASE 50.—E. B., æt. 21, female, admitted October 2nd (fifth day of illness). Early part of illness severe; duration seventeen days. Highest temperature 105°; bowels constipated. No complications. Good recovery. Discharged November 27th.

CASE 51.—F. F., æt. 32, female, admitted October 2nd (thirteenth day of illness). A rather mild though long attack; duration thirty-four days. Highest temperature 103.6°; diarrhœa during the earlier part of her illness; constipation later; no complications. Good recovery. Discharged November 22nd.

Her husband and son (Cases 60 and 61) were also treated in the hospital.

CASE 52.—E. B., æt. 13, male, admitted October 2nd (sixth day of illness). A very severe case; duration twenty-two days. Highest temperature 105.4°; roseola present; diarrhœa during the second week; extremely delirious, and had to be fed by nutrient enemata, as he sometimes refused food; on one occasion he had retention of urine, necessitating the use of a catheter; bronchitis and hypostatic congestion of lungs at the height of the illness. He made a good recovery. Discharged November 20th.

CASE 53.—J. W., æt. 39, male, admitted October 2nd (tenth day of illness). A severe attack; duration of pyrexia fifty-seven days; roseola present; bowels generally constipated; delirium during the earlier part of illness. The severity of this case arose chiefly from complications. Rigors frequently occurred between the thirty-second to the forty-fourth days, eleven being recorded during this period (Chart XII.). They were associated with sudden rise of temperature, rapid pulse, and cyanosis, and followed by sweating. On October 20th (twenty-eighth day) there was evidence of thrombosis of left femoral vein. Patient first complained of pain in the groin, and there was tenderness in the course of the vein; later the vein stood out and felt like a cord passing down Scarpa's triangle; it was followed by much œdema of the whole left lower extremity. A splint had to be applied as patient would not keep his leg still. On the 19th of November, the right femoral vein became thrombosed, but much less extensively. Right foot was swollen but not so much as left, and the venous circulation was soon re-established. When the first rigor occurred on October 24th (the thirty-second day), it was feared that pneumonia had set in, as, on examining the chest, there was impaired resonance on percussion at the left base behind, extending almost as high as spine of scapula; and on auscultation distant tubular breathing was heard over the same area. On the following day an exploring needle was put into left pleura, and some clear serous fluid was drawn off which coagulated very rapidly. The rigors occurred on the following days:—two on the thirty-second day, one on thirty-third, thirty-fifth, thirty-sixth, and thirty-eighth days, two on the thirty-ninth day, and one on forty-first, forty-second and forty-fourth

days. With regard to the cause of the frequent recurrence of the rigors, the following possibilities occurred to us at the time, viz.:—that the effusion might have become purulent; that they might be due to the thrombosis of femoral vein; that the clot might have broken down and given rise to pyæmia; or that they might have been caused by compression of the lung by a non-purulent pleuritic effusion. An arrangement was made to again explore left pleural cavity with a needle a few days later, but on examining the chest there was evidence that the effusion was diminishing, and, as the patient did not seem to be losing ground, this step was postponed. The rigors ceased after the forty-fourth day and improvement commenced. For a long time afterwards he sweated most profusely at night. There were no physical signs of phthisis at either apex. The patient told me that he had previously suffered from repeated attacks of pleurisy. On November 16th, two days before the temperature finally settled down to normal, he complained of severe pain in the lumbar and upper sacral regions; it was deep-seated, and worse on moving. Tapping the spines of vertebræ in this region was also rather painful to the patient. No girdle pain. Tenderness on making deep pressure above the crests of both ilia. Sensation to touch in both extremities good. Knee-jerks, which at first were about normal, were later unduly brisk. It was impossible to say if there was any loss of power in lower extremities on account of the thrombosis of femoral veins. Feet were cold, blue, and moist. The pain was little relieved by local treatment, but heat in the form of a rubber hot-water bottle applied to the painful part seemed to give most relief; draughts of hot brandy and water also appeared to diminish the pain. He was allowed to get up for the first time just before Christmas, but the pain became so much worse that he was kept in bed again until early in February, when the pain almost entirely left him. He gave a history of having hurt his back four or five years previously in carrying a sack of peas, from which he quite recovered. This condition seemed to correspond rather closely with what Dr. Gibney has called "Typhoid Spine." The doctor who had been attending him before his admission into the hospital, told me that he had suffered from some venereal disease a few years previously. I could find no evidence of syphilis. His urine was free from albumen. There was a good deal of œdema of the left leg when he was discharged on February 25th; otherwise he made a good recovery.

CASE 54.—W. C., æt. 23, male, admitted October 2nd (? fifth day of illness). Patient took to his bed on September 28th on account of severe headache; he had not been feeling quite well for nearly a fortnight before this date. On admission, temperature 98·8°; roseola observed four days later. Very slow pulse during convalescence. He must have had a very mild attack. Discharged November 13th.

CASE 55.—S. T. W., æt. 9, male, admitted October 2nd (sixth day of illness). A mild attack; duration eleven days. Highest temperature 102·8°; roseola present; bowels constipated. Periostitis of rib in right axilla, fifteen days after convalescence had commenced; it did not suppurate, but left some thickening of the bone. Discharged November 13th.

Father admitted into hospital (Case 149).

CASE 56.—T. D., æt. 6, male, admitted October 2nd (tenth day of illness). A mild case; duration fifteen days. Highest temperature after admission 101°; bowels constipated; there was a little bleeding from the gums on

October 4th. Slight rise of temperature for a few days after temperature had been normal more than a week; this was probably due to constipation. Discharged November 20th.

CASE 57.—A. R., æt. 14, male, admitted October 2nd (fifteenth day of illness). A severe case; duration twenty-four days. Highest temperature 104.2° ; diarrhœa, bronchitis, and delirium; rapid pulse; severe headache on admission. Good recovery. Discharged November 13th.

CASE 58.—F. McC., æt. 15, male, admitted October 2nd (sixth day of illness). A mild case; duration twenty days. Highest temperature 103.3° bowels constipated: no complications. Good recovery. Discharged November 13th.

CASE 59.—S. B., æt. 13, male, admitted October 2nd (ninth day of illness). A mild case. Highest temperature 102.4° ; duration twelve days; bowels constipated; diarrhœa two days before admission.

Father treated in hospital (Case 117.)

CASE 60.—W. F., æt. 8, male, admitted October 2nd (thirteenth day of illness). A rather mild case; duration twenty-nine days. Highest temperature 102.8° ; roseola present; obstinate constipation. The temperature rose on several occasions during convalescence, once reaching 102.2° ; at the same time the tongue was much furred; this occurrence was probably due to constipation; it much delayed his discharge from the hospital. He was discharged on January 3rd.

His mother and father were also treated in hospital (Cases 51 and 61).

CASE 61.—A. J. F., æt. 35, male, admitted October 2nd (twelfth day of illness). A rather severe case, with relapse; duration of primary attack thirty-five days. Highest temperature 106.2° . Diarrhœa during the third week; roseola present; rapid pulse; retention of urine on fourteenth day, when catheter had to be passed. On October 8th (eighteenth day) at 2 p.m. patient had a rigor. Temperature rapidly rose to 106.2° (Chart VII.); it was quickly reduced by sponging and ice-bags placed in axillæ. He had another slight rigor at 6 p.m. On looking for an explanation of this occurrence we could find no physical signs of any complication in the chest or elsewhere. On the following morning, however, we learnt that one of the scrubbers employed in the ward had told the patient just before the onset of the rigor that his wife lay seriously ill in the ward above; in the absence of any other assignable cause, it seems probable that this condition was brought about by the shock of hearing bad news. A mild relapse commenced eleven days after temperature had reached normal, and lasted fourteen days. A fresh crop of spots appeared on the sixth day of relapse. He was very tremulous throughout his illness, and pulse kept rapid for some time after convalescence had commenced. Heart normal. Good recovery. Discharged January 3rd.

CASE 62.—A. B., æt. 5, male, admitted October 3rd (fourth day of illness). A moderately severe case; duration twenty-four days. Highest temperature 103.2° ; roseola present; vomiting during the first week of his stay in the hospital; a little diarrhœa in the second week; no delirium. Temperature raised on several occasions during convalescence, probably due to constipation. Good recovery. Discharged December 14th.

CASE 63.—J. R., æt. 17, male, admitted October 3rd (ninth day of illness). A mild case; duration twenty-six days. Highest temperature 103.4° ; roseola present; bowels constipated. Discharged November 22nd.

CASE 64.—W. J. C., æt. 38, male, admitted October 3rd (fourth day of illness). A mild case; duration twenty-one days. Highest temperature 103.2° ; roseola present; bowels constipated; retention of urine from the fifth to fourteenth day of illness. Good recovery. Discharged November 22nd.

CASE 65.—F. S., æt. 13, male, admitted October 3rd (eleventh day of illness). A moderately severe case; duration twenty-eight days; highest temperature 104.2° ; roseola present; a little delirium; diarrhœa during the third and fourth weeks; tongue kept furred during convalescence; and there were several slight rises of temperature, probably due to obstinate constipation. Discharged December 14th.

CASE 66.—H. B., æt. 8, male, admitted October 3rd (fourteenth day of illness). A mild case; duration thirty days. Highest temperature 103° ; roseola present; bowels constipated. *Sequela*:—Small abscess formed in front of trachea five days after temperature had reached normal; it was accompanied by slight rise of temperature; no redness of skin over it and no signs of very acute inflammation. It was opened under an anæsthetic on November 2nd. After he had been removed to the transfer-hospital he had a smart attack of follicular tonsillitis. Discharged January 20th.

CASE 67.—L. B., æt. 8, male, admitted October 3rd (seventh day of illness). A moderately severe attack; duration twenty-eight days. Highest temperature 104.8° ; roseola present; diarrhœa during the second week, constipation afterwards. Two small hæmorrhages about three weeks after convalescence had commenced—the first was after the administration of an enema on the 15th of November, the second on the following day. Good recovery. Discharged January 1st.

CASE 68.—J. F., æt. 27, male, admitted October 3rd (fourteenth day of illness). This patient, who said he had been ailing since the end of August, gave the following history:—For some time previously he had been working in the country during the week, but on Sundays he took all his meals at his home in Maidstone, and usually drank two glasses of water with his dinner. The water supplied to the house came from the springs which were thought to be contaminated. He had had diarrhœa frequently since the beginning of August; it was much worse on Mondays than any other day of the week. He took to bed on September 27th, and for a week previous to this date felt much more ill than before. On admission his temperature was 98.8° , and for twenty-five days after admission temperature (taken morning and evening) was never above 99.2° , and bowels were much constipated, requiring the frequent administration of enemata. Several doubtful typhoid-spots were observed on abdomen on October 6th. The doctor who had been attending him before his admission into the hospital thought him to be suffering from a mild attack of typhoid, and it was only the following occurrence that gave us doubt on the subject. His temperature, which was 98° on the morning of October 27th, gradually rose until it reached 105° on November 6th. Several crops of typhoid spots appeared; bowels were generally constipated, but were a little loose at the end of the second week of his illness. There were two slight hæmorrhages on the seventeenth day. This attack was severe and lasted thirty-three days. Eleven days after the temperature had become normal he complained of pain in left axilla on breathing. The temperature again rose to 102° . Shortly afterwards a pleuritic rub was heard over the painful area and

resonance became a little impaired. Under treatment these signs soon disappeared. It was difficult to decide whether this last described attack was a relapse or a primary attack; we were, of course, much handicapped in seeing only the termination of the first illness, and in not possessing records of the patient's temperature before admission. The history of his having suffered for an indefinite period before admission with diarrhoea, headache and malaise, and of his having freely drunk contaminated water previously, supports the view that the first illness was due to typhoid. Against this view are the facts that he had such a severe attack after admission, whilst the first attack, if due to typhoid, must have been a very mild one; and, secondly, the apyrexial interval between the two illnesses was unusually long. Now, supposing the second illness was a primary attack of typhoid and not a relapse, how could infection of the patient have come about? It is true that a non-typhoid patient in a ward surrounded by cases of typhoid, must necessarily be exposed to slight risks of infection by aerial transmission. But the following possibility in this case has occurred to me. I have mentioned above that there was constipation, requiring the administration of enemata; and it seems probable that infection might be conveyed by means of an enema-syringe, which had previously been used for patients suffering from typhoid, if it were employed in the case of one who had not been protected by a previous attack of the disease. I fear that this patient was unwittingly exposed to this risk, as it was not until the second illness occurred that we doubted the correctness of the diagnosis on which he was admitted. The patient made a good recovery and was discharged on January 22nd.

CASE 69.—M. S., æt. 23, female, admitted October 3rd (sixth day of illness). A moderately severe attack; duration thirty-three days. Highest temperature $101\cdot4^{\circ}$; roseola present; constipation during second week; diarrhoea during the third and fourth weeks. Good recovery. Discharged December 31st.

CASE 70.—N. F., æt. 11, female, admitted October 3rd (eighth day of illness). A rather severe attack, but uncomplicated; duration thirty-five days. Highest temperature $105\cdot2^{\circ}$; bowels constipated. Good recovery. Discharged January 17th.

CASE 71.—E. W., æt. 13, female, admitted October 3rd (seventh day of illness). A mild though rather long attack; duration thirty-five days. Highest temperature $103\cdot4^{\circ}$; bowels constipated; some periostitis of lower jaw and a small abscess around a carious tooth on November 16th, which probably had no connection with the typhoid. Discharged January 20th.

CASE 72.—G. H., æt. 10, female, admitted October 3rd (thirteenth day of illness). A severe attack with much noisy delirium; duration (including a slight recrudescence between the thirty-fifth and thirty-ninth days) thirty-nine days. Highest temperature $104\cdot4^{\circ}$; rapid pulse; roseola present; diarrhoea. Good recovery. Discharged January 20th.

CASE 73.—L. L., æt. 21, female, admitted October 3rd (seventeenth day of illness). A very severe attack, with relapse; duration of primary attack fifty-six days. Temperature once became normal on the morning of the twenty-eighth day, after increasing morning remissions of temperature during the four previous days. It again reached 103° on the evening of the twenty-ninth day, and afterwards ran a remittent course until the fifty-sixth day, when it became normal. In the statistics this has been considered as one

attack, but it would perhaps be more reasonable to look upon it as a primary attack running a course of twenty-eight days, the termination of which is slightly overlapped by the commencement of a relapse, also running a course of twenty-eight days. This view is rather supported by the occurrence of two hæmorrhages of 2 ounces and 8 ounces respectively on October 5th (nineteenth day), and a recurrence of hæmorrhage, 10 ounces, on October 25th (thirty-ninth day), and 8 ounces on October 27th (forty-first day). If the latter period of pyrexia be looked upon as a relapse, these last two hæmorrhages would have occurred on the twelfth and fourteenth days of the relapse, about the period that hæmorrhage from fresh ulceration might be expected. Roseola present, though only a few spots were observed; diarrhœa from time to time; spleen was not palpable; the pulse was small and rapid, almost throughout illness; sometimes it was uncountable, especially after the hæmorrhages on the thirty-seventh and thirty-ninth days. From the physical signs there is little doubt that she was suffering from mitral constriction and regurgitation and a dilated right ventricle, and after the hæmorrhages it appeared that patient must succumb to cardiac failure. It was not thought advisable to employ cardiac stimulants very freely through fear of recurrence of hæmorrhage; frequent hypodermic injections of strychnine were given with success. After an interval of three days' apyrexia a mild relapse occurred, lasting seventeen days. On the third day of this relapse the left breast became inflamed and painful; it was treated with belladonna fomentations, and resolved without suppuration. There was slight periostitis of right ulna following a blow just before patient left the hospital. She stated that she had suffered from a long and severe attack of rheumatic fever two or three years previously. There was much œdema of both legs for a few days after she first got up; it was probably due to the condition of her heart. She made a fairly good recovery and was discharged on February 26th.

CASE 74.—J. K., æt. 9, female, admitted October 3rd (fourteenth day of illness). A moderately severe attack; duration thirty-eight days. Highest temperature 104.6° ; bowels constipated; several slight rises of temperature during convalescence; tongue remained large and flabby, and was covered with white fur. On November 27th there was a rise of temperature for three days, once it reached 101.8° . I could find no cause other than constipation for this occurrence. Small hæmorrhage (about half-ounce) on thirty-third day of illness. Good recovery. Discharged January 12th.

CASE 75.—A. C., æt. 22, female, admitted October 3rd (third day of illness). A mild attack; duration twenty-three days. Highest temperature 104° ; diarrhœa at the beginning of the third week. "Woodbridge treatment" adopted in this case. Good recovery. Discharged November 27th.

CASE 76.—E. T., æt. 20, female, admitted October 3rd (fifth day of illness). A rather severe case with two relapses, the first relapse being more severe than the primary attack; duration of primary attack seventeen days. Highest temperature 103° ; roseola present; bowels at first constipated but a little diarrhœa later after the administration of an enema. The first relapse commenced after five days' apyrexia; duration twenty-one days. A fresh crop of spots appeared and the bowels were loose; after an interval of less than twenty-four hours' of apyrexia a second and less severe relapse occurred, lasting fourteen days. Good recovery. Discharged January 1st.

CASE 77.—R. F., æt. 23, female, admitted October 3rd (eleventh day of illness). Patient was taken in at the end of the primary attack; duration

sixteen days. Highest temperature 103° ; diarrhœa; roseola not observed; spleen enlarged. After eight days' apyrexia a most severe relapse set in. Temperature rose rapidly and reached 104° on the first day of relapse (Chart I.). Highest temperature during the relapse 104.4° . Very rapid pulse; spleen much enlarged; no rash seen; very severe diarrhœa; motions contained much undigested curd of milk; she refused food; severe bronchitis. Good recovery; discharged December 8th. Her father was in hospital (Case 68).

CASE 78.—L. L., æt. 14, female, admitted October 3rd (fifth day of illness). A moderately severe attack; duration twenty-nine days. Highest temperature 105.2° ; diarrhœa at the commencement of the first week; no complications. Good recovery. Discharged December 9th.

CASE 79.—P. I., æt. 16, female, admitted October 3rd (twelfth day of illness). A mild attack; duration twenty days. Highest temperature 103° ; a little diarrhœa during the second and third weeks; no complications. Good recovery. Discharged November 17th. Her mother was in hospital (Case 80).

CASE 80.—U. I., æt. 39, female, admitted October 3rd (tenth day of illness). A moderately severe attack; duration twenty-seven days. Highest temperature 105° ; constipation towards the end of illness. I was told that this patient had been an inmate of an asylum sometime previously; she was not at all mentally afflicted after this depressing illness. Discharged November 17th. Her daughter was in hospital (Case 79).

CASE 81.—K. S., æt. 15, female, admitted October 4th (twelfth day of illness). A mild case, almost convalescent on admission; duration twelve days. Highest temperature recorded 100.2° ; bowels constipated. Discharged November 1st.

CASE 82.—H. A., æt. 6, male, admitted October 4th (eleventh day of illness). A mild though rather long attack; duration thirty-six days; the later period of pyrexia may be looked upon as a recrudescence of the fever. Highest temperature 101.6° ; bowels constipated. Discharged December 4th.

CASE 83.—C. K., æt. 16, female, admitted October 4th (ninth day of illness). A moderately severe attack; duration twenty-eight days. Highest temperature 104° ; roseola present; diarrhœa; pulse very rapid and feeble throughout illness; patient had dyspnœa at times; there were no physical signs of cardiac disease; she gave a history of having had rheumatic fever sometime previously. There was an explicable rise of temperature to 102° on one occasion during the night, twenty-five days after convalescence had commenced; slow recovery. Discharged November 17th.

CASE 84.—W. U., æt. 12, male, admitted October 4th (seventh day of illness). A moderately severe attack; duration twenty-two days. Highest temperature 104.2° ; roseola present; bowels constipated until the third week, when there was slight diarrhœa. There were several small rises of temperature during convalescence, and tongue remained furred—probably due to constipation. Good recovery. Discharged December 14th.

CASE 85.—J. R., æt. 7, male, admitted October 5th (seventh day of illness). A moderately severe attack; duration twenty-seven days. Highest temperature 104.2° ; roseola present; bowels constipated. There was a rise of temperature for a few days three weeks after it had previously become normal; no fresh spots appeared. Probably this was not a relapse; it, however, hindered his being discharged. Discharged January 3rd.

CASE 86.—D. S., æt. 6, female, admitted October 6th (sixth day of illness). A mild attack; duration nineteen days. Highest temperature 103° ; bowels constipated. Good recovery. Discharged November 20th.

CASE 87.—A. T., æt. 19, female, admitted October 25th (seventh day of illness). This patient had been working as ward-maid in one of the Emergency-hospitals for three weeks previous to the commencement of her illness. On October 13th she was slightly burnt about the face through a small gas explosion, and had to relinquish her duties for five days. She returned to work until October 22nd, on which day she took to bed. She stated that she had not been feeling well since the accident occurred, and had suffered with headache and had felt languid. In this case I fixed the date of onset as October 19th. A most severe attack followed, with continuous high temperature during the first fourteen days of her stay in the hospital, which several times rose higher after sponging—an operation which she rather objected to. Duration of pyrexia thirty-three days. Highest temperature 105.6° ; profuse roseola; very troublesome vomiting during the earlier part of her illness; much delirium; tongue dry, and teeth covered with sordes; bowels constipated; bronchitis and hypostatic congestion of lungs. Constipation was most obstinate during convalescence. In the early morning of November 1st (fourteenth day of illness) a rigor occurred (Chart IX.). Temperature rose from 101.8° to 105.6° ; pulse 144; respiration 40. The bowels had not been opened for two days but were shortly afterwards relieved by an enema. Another rigor occurred in the early morning of November 4th, when temperature rose from 101.6° to 103.8° . On this occasion the bowels had not been opened for three days; an enema was again administered. Small doses of phenacetin had been given on the 26th, 27th, 29th, 30th and 31st of October to relieve the headache, and to reduce the patient's temperature. She made a very good recovery and was discharged on January 1st.

CASE 88.—A. G., æt. 34, female, admitted October 25th (forty-seventh day of illness). A long and severe attack; duration seventy-eight days. Highest temperature recorded 105° ; doubtful typhoid spots noticed on abdomen shortly after admission. Pulse rapid and feeble; bowels constipated during the whole of stay in hospital; she vomited several times. Rigors occurred frequently throughout her illness (Chart XIII.); during her stay in the hospital they were recorded on October 28th, 29th and 31st, and on November 4th; no inflammatory complication could be found to account for these, and from the history they occurred more frequently before she was admitted; they were associated with rises of temperature, sometimes to between 104° and 105° , and gave to the pyrexia an intermittent and remittent character. She was a very excitable patient, and a visit from the doctor would be quite sufficient to cause her to tremble, and make her pulse so rapid as to be almost uncountable. She had never suffered from ague. Very severe hæmorrhages occurred on the 27th and 28th of September (about a month before admission), and were associated with depression of temperature. Two small hæmorrhages (2 ounces each) occurred on the fifty-seventh day of illness, and were followed the same evening by a rigor and a rise of temperature from 98.2° to 103° . Thrombosis of left femoral vein set in, with local pain and tenderness, on November 26th, the day after temperature became normal; it was not accompanied by pyrexia. She progressed satisfactorily while she remained in the hospital, but by her own wish, and

contrary to advice, she left sooner than she should have done and followed her household duties, with the result that the leg became more and more œdematous. Date of discharge, January 2nd.

CASE 89.—L. C., æt. 30, female, admitted October 27th (fourteenth day of illness). This was probably not a case of typhoid; for a fortnight before admission she had complained of headache and pains in the legs, back and stomach; she had had no diarrhœa, and had kept about until the day she was admitted to the hospital; slight epistaxis at the commencement of her illness. On admission, tongue was coated with white fur; no rash; temperature was normal; no gastric symptoms; bowels much constipated. No means of infection could be traced; she did not live in the area supplied by Farleigh water, nor had she been nursing any typhoid cases. Discharged December 13th.

CASE 90.—C. R., æt. 19, male, admitted October 27th (eighth day of illness). A mild attack; duration twenty-four days. Highest temperature 101.8° ; bowels constipated; some doubtful typhoid-spots observed on the twenty-second day of his illness; tongue covered with white fur. Illness commenced with headache and feeling of languor; he took to bed on October 24th. His sister had been suffering from typhoid and had been nursed at home; he often used to sit in her room when she was ill. His father had been ill with typhoid since September 29th; he slept in his father's bed after the latter had been removed to the hospital on October 12th. It is probable that he contracted the disease from one of these patients. Discharged December 23rd.

CASE 91.—A. M., æt. 46, female, admitted October 27th (? twenty-ninth day of illness). This patient had been ailing for about five weeks before admission. Her illness commenced with headache and malaise. She had been attended by a medical man at her home for four weeks previous to admission; there had been several slight rises of temperature; diarrhœa occurred at the end of the third week and continued for a fortnight; she was sick once in the third week. Temperature was never above 99° after admission; bowels much constipated; tongue remained furred for a considerable time; she complained of discomfort after first taking solid food. This was probably not a case of typhoid. She was discharged on December 13th.

CASE 92.—E. L., æt. 13, female, admitted October 29th (thirteenth day of relapse). Primary attack occurred outside hospital; a rather severe relapse set in after one day's apyrexia. Highest temperature 105° ; a little bronchitis and diarrhœa. Duration of relapse twenty-one days. Probable duration of primary attack nineteen days. Good recovery. Discharged January 1st.

CASE 93.—H. L. æt. 10, male, admitted October 29th (fifteenth day of illness). Three of this family had been suffering from typhoid before the patient was taken ill. He had nearly reached convalescence when admitted. Highest temperature 100° ; spleen palpable: a mild case. Discharged January 1st.

CASE 94.—T. L., æt. 14, male, admitted October 29th (thirtieth day of illness). A severe case with two relapses. Patient was admitted on the evening of October 29th, apparently the third day of relapse, with a temperature of 106.4° ; pulse 156; respiration 40 (Chart X.); temperature was brought down by sponging to 105.4° . At 10 p.m. two and a half grains of Phenacetin was given; at 2 a.m., October 30th, temperature 100.4° , pulse 110; at 6 a.m.

a rigor occurred, lasting twenty minutes, and at 8 a.m. temperature reached 105.4° ; after sponging with tepid water it was 101.6° . Shortly after noon patient had another rigor, lasting fifteen minutes, and at 2 p.m. temperature reached 104.6° . The next rigor occurred at 10 p.m. on November 1st, and at midnight temperature was 106° ; pulse 140. Two and a half grains of Phenacetin was given. At 6 a.m., November 2nd, temperature had fallen to 98° , but shortly afterwards another rigor occurred, temperature reaching 103.4° at 8 a.m. The last rigor occurred in the afternoon of November 10th, and lasted ten minutes, temperature rising to 102.4° . The temperature finally settled down to normal on November 15th, the forty-seventh day of illness, and twentieth day of relapse. During the whole of this period he was exceedingly irritable and frequently delirious; often he was much cyanosed, particularly during the rigors; he lay curled up in bed, complaining of feeling cold; respirations were rapid and pulse feeble; there were physical signs of bronchitis and hypostatic congestion of bases of lungs, but no evidence of pneumonia; bowels were loose; spleen much enlarged; no rose spots were observed; tongue was large and red, and marked by deep transverse fissures. A second relapse set in after an interval of fourteen days' apyrexia; initial rise of temperature was accompanied with headache. Highest temperature 102.6° . It ran a mild course of ten days. As convalescence was reached he complained of much pain on the inner side of right knee. No cause could be found for this, and there was no obvious thickening of the bone. Legs became oedematous after his first getting up; there was no evidence of thrombosis of veins. Little information was obtained about the primary attack, which was said to have commenced on September 30th. The morning and evening temperature-chart shows several rapid rises of temperature, once to 105° , separated by intervals of temperatures below 100° . He made a good recovery, and was discharged on January 20th.

CASE 95.—L. T., æt. 11, female, admitted October 30th (third day of illness). *History.* There had been no other case of typhoid in the house previous to patient's illness. Her father was at home ill with bronchitis in October, and was said not to be suffering from typhoid. Her mother worked as a scrubber at one of the Emergency-hospitals; she went home at meal-times and prepared the food for her family. Patient's illness commenced two days before admission, with severe headache. She had been occupying the same bed as her two younger sisters, who were admitted into the hospital a few days later with typhoid; the dates of their attacks were October 31st and November 6th respectively. Patient had a most severe attack; pyrexia ran an almost continuous course of seventy-eight days; between the thirty-eighth and forty-fourth days, however, the temperature was not above 100° , and for more than thirty-six hours on the forty-third and forty-fourth days it was not above 99° . From the latter day onwards temperature gradually rose in the evenings until the fiftieth day, when it reached 103.4° , the morning temperatures not being above 100° , and did not settle down to normal until the seventy-eighth day. In the statistics this has been considered a relapse; it was treated as such, although no fresh spots were observed. Roseola present during the earlier part of the illness; bowels very loose during the second, third, and fourth weeks of illness; spleen palpably enlarged; much delirium and bronchitis. On the twenty-sixth day of illness, at 8 a.m., she passed about two drachms of blood mixed with fecal matter, and at 6 p.m. the same day,

ten ounces of bright red blood ; she was also sick ; pulse was rapid and feeble, and her condition, which was serious before this occurrence, became more so ; improvement soon followed. In the beginning of January patient complained of pain in right elbow ; there was tenderness over the posterior surface of the lower end of humerus, but no thickening of the bone. Pain was worse on flexing and extending the arm ; it was much relieved by the application of hot belladonna fomentations. She again complained of her elbow being painful on February 6th ; at this period there were irregular rises of temperature (once it reached 101.6°), only to be accounted for by the condition of her arm. There was a little thickening of the posterior surface of the lower end of humerus as well as of the anterior surface, just to inner side of biceps tendon. Biceps muscle was rigid, and the arm could not be straightened without causing pain. Rest and the application of belladonna fomentations soon relieved pain, but a little bony swelling still remained. The later periostitis probably arose from an epiphysitis of the lower end of the humerus. There were never signs of the presence of fluid in the elbow joint. In the middle of March there was tenderness and swelling of one of the metatarsal bones, evidently due to periostitis. Patient was a very weakly looking child. I have mentioned later that her sister (Case 110) presented the facial appearance of a child with congenital syphilis ; but no evidence of the disease was found in this patient. Fair recovery. Discharged March 28th.

CASE 96.—I. P., æt. 43, female, admitted October 30th (eighth day of illness). A moderately severe attack. Highest temperature 103.8° ; duration thirty-five days ; roseola present ; slight diarrhoea ; spleen palpable ; retention of urine, necessitating use of catheter on November 4th. Good recovery ; discharged June 5th.

CASE 97.—W. S., æt. 6, male, admitted October 30th (eighteenth day of illness). The doctor who had been attending him up to date of admission gave me the following history :—He first saw him on October 15th, the third day of illness ; he then complained of pains in head and stomach, and had had epistaxis ; he had vomited several times ; bowels were loose, stools were dark and foul ; a little delirium at night ; temperature 102° ; it became normal on October 18th. On October 20th his nose bled again and he vomited. On October 26th temperature again rose, and reached 103° two days later ; there was difficulty in getting him to take his food. On this day a general erythema appeared all over body, face, and extremities. He was sent to the hospital as a case of relapsing typhoid. On admission, the rash was fading, and there was desquamation all over body and neck, and some on scalp around roots of hair. Tongue was rather red, papillæ around edges enlarged ; throat a little injected ; chronic enlargement of both tonsils and submaxillary lymphatic glands ; spleen palpable ; no albuminuria ; right otorrhoea of old standing. The epidermis became detached in large flakes, and this took place all over the body at the same period ; the rash about knees was undoubtedly of the nature of eczema, and there was a patch of eczema on face. I consulted with my colleagues and we came to the conclusion that it was certainly not scarlatina, and we were very doubtful as to the correctness of the diagnosis on which the patient was admitted. There was no further rise of temperature until just before Christmas, when a few days' pyrexia was probably due to gastric disturbance. Good recovery ; discharged January 3rd.

CASE 98. N. S., æt. 23, female, admitted October 31st (eighth day of illness). A moderately severe attack with two relapses; duration of primary attack sixteen days. Highest temperature 104.4° ; roseola present; bowels constipated; spleen palpably enlarged; epistaxis on sixteenth day. First relapse set in after a few hours' apyrexia and lasted twenty-five days; second relapse after five days' apyrexia; duration ten days. Good recovery; discharged January 29th.

CASE 99.—F. S., æt. 2, male, admitted October 31st (? thirty-second day of illness). A mild attack; duration ? forty-one days. Highest temperature after admission 103.2 ; roseola not observed; spleen much enlarged; bowels constipated; slight bronchitis. On November 22nd temperature rose to 100.6° and a painful swelling appeared at lower end of left radius; it is possible that this periostitis was caused by an injury, unnoticed at the time, through a fall on the day after admission. It cleared up without suppuration. Discharged January 4th.

CASE 100.—H. W., æt. 4, female, admitted November 1st (thirteenth day of illness). A mild attack; duration twenty days. Highest temperature 103.4° ; spleen much enlarged; roseola not observed; bowels constipated. Discharged December 8th.

CASE 101.—A. M., æt. 5, female, admitted November 3rd (eighth day of illness). A mild attack; duration twelve days. Highest temperature 103° ; roseola not observed; bowels constipated; spleen not palpable; ten days after temperature had become normal there were signs of inflammation in middle of calf of leg; a little later, fluctuation could be obtained through the reddened skin. An abscess was opened in this position on November 20th. A pure culture of streptococcus was obtained from the pus; the pus serum did not give the typhoid "clumping reaction." It was probably a mild case of typhoid. Discharged January 12th.

CASE 102.—A. W., æt. 37, female, admitted November 3rd (fifteenth day of relapse). A moderately severe relapse; duration twenty days. Highest temperature recorded during illness 104° ; roseola observed after admission. Bowels constipated; primary attack occurred outside the hospital; duration probably about thirty days; relapse preceded by seven days' apyrexia. Patient had bad varicose veins, and on this account was given a prolonged rest during convalescence to prevent thrombosis. Good recovery. Discharged January 5th.

CASE 103.—A. M., æt. 33, female, admitted November 4th (seventh day of illness). A severe case, almost from the first. Patient probably contracted the disease from her child whom she had been nursing with typhoid. The Woodbridge treatment was adopted in response to the wishes of a doctor who had been attending her previous to her admission; after four days, diarrhoea occurred, and bowels continued loose throughout illness. During the first week of patient's stay in hospital the evening temperature generally reached 104° , and there were morning remissions. Several small doses of Phenacetin were given to relieve headache and reduce the temperature. Highest temperature recorded during illness 104.8 ; roseola present; spleen much enlarged; tympanites during third week of illness; after the thirteenth day pulse-rate was nearly always more than 120 and respiration-rate 28 to 40. On the sixteenth day patient passed about two ounces of blood in stool, and on the nineteenth day half-an-ounce. Alcoholic stimulants were temporarily with-

held through fear of a recurrence of the hæmorrhage. At 10 a.m. on the twenty-first day there was cyanosis; and at 2 p.m. temperature 104.8° was brought down by sponging to 101.2° ; pulse 140; respiration 36; abdomen was distended but not rigid; she complained of pain to right of umbilicus; on examining the chest the same evening there was found to be deficient resonance on percussion at the left base behind, and numerous crepitations were heard over the same area. On the twenty-second day at two a.m. temperature 102° , pulse 148, respirations 42; at 7.30 a.m. temperature 104.4° , pulse 184, respirations 60. She rapidly sank, and died at 10 a.m. During the last few hours of her life she vomited dark fluid, and after death similar black frothy matter was regurgitated through nose and mouth. In the absence of definite physical signs it must remain doubtful whether perforation had taken place, and whether there was early pneumonia at the left base. An autopsy was not allowed.

CASE 104.—G. W. R., æt. 45, male, admitted November 4th (? twenty-seventh day of illness). Patient probably contracted the disease through nursing his children who had been suffering from typhoid in September. He had been ailing since October 9th, but did not take to his bed until November 1st. Probable duration of primary attack forty-five days; roseola present; spleen enlarged; a little diarrhæa. Relapse commenced on December 2nd, after nine days' apyrexia; duration twenty days; highest temperature 104° ; roseola very profuse; spleen very much enlarged; severe diarrhæa during height of attack; stools contained a quantity of undigested milk-curd; some bronchitis, from which patient frequently suffered during the winter; retention of urine on one occasion. He had a most severe relapse; discharged February 1st.

CASE 105.—G. K., æt. 18, male, admitted November 8th (fourteenth day of illness). Disease was probably contracted from sister, though by what means is not quite clear. He had a rather severe attack; duration forty-five days; temperature not above 100° after the thirty-eighth day; highest temperature 104° ; spleen not palpable; roseola present; severe headache during early part of stay in hospital; diarrhæa; retention of urine on November 10th, when a catheter had to be passed. On the morning of November 14th an urticarial rash appeared all over body and extremities; there was more on back than on front of chest and abdomen. It itched very much. It had quite disappeared at the end of the day. An enema saponis had been administered four days previously. Good recovery; discharged January 20th.

CASE 106.—K. L., æt. 15, female, admitted November 8th (sixteenth day of illness). Probably a case of typhoid, but a very mild one. She had assisted in nursing a typhoid patient before she was taken ill. Her first symptoms were headache, vomiting, and malaise; duration of illness nineteen days. Highest temperature after admission 100.4° . No roseola observed; bowels constipated. She commenced to menstruate almost immediately after admission, and this continued for six days. Good recovery. Discharged December 17th.

CASE 107.—G. H., æt. 35, male, admitted November 8th (? fifty-second day of illness). Patient was admitted to the hospital after a long period of pyrexia, broken only by two short intervals of apyrexia; temperature first became normal on October 9th (twenty-second day), and within twenty-four hours began to rise again until October 13th, when it touched 103° . It

again became normal on October 21st (thirty-fourth day), and kept below 99° for four days; then another relapse occurred lasting eleven days. On November 26th, after twelve days' apyrexia, and eighteen days after his admission to the hospital, a third and most severe relapse commenced; duration twenty-two days. Highest temperature 103.2°; profuse roseola; a little diarrhoea; spleen not felt; some delirium and strange delusions. At this period it was difficult to get patient to take nourishment, as he thought it was wicked to take food. Teeth became very loose towards the end of the illness; there was extreme emaciation. Profuse intestinal hæmorrhages occurred on December 15th and 17th. On the former day, in the early morning, he passed about half a pint of blood, and temperature fell to sub-normal; on the latter day he passed about a pint of blood, pulse became rapid, and he almost collapsed. Improvement commenced immediately afterwards, and temperature remained subnormal. He made an excellent recovery. Discharged January 29th.

CASE 108.—A. T., æt. 2½, female, admitted November 9th (tenth day of illness). A severe attack, the seriousness arising through the difficulty of administering food; duration sixteen days. Highest temperature 104°; diarrhoea; no roseola observed. *Sequela*.—On December 29th, when patient had been convalescent about six weeks, slight jaundice appeared. She vomited several times and lost her appetite; temperature once reached 99.6°, it having previously been subnormal; bowels constipated; stools deficient in bile-pigment, urine bile-stained. All these symptoms disappeared in the course of a week, and she seemed quite well again. Discharged January 5th.

CASE 109.—R. H., æt. 30, male, admitted November 11th (tenth day of illness). A moderately severe attack; duration thirty-nine days; highest temperature 103.6°; roseola present throughout illness. Two small hæmorrhages, the first (about half an ounce) on the twenty-fourth day of illness, the second (about one ounce) on the twenty-fifth day. Discharged January 5th.

CASE 110.—F. T., æt. 5, female, admitted November 11th (sixth day of illness). A rather severe attack. Highest temperature 104.6°; duration twenty-six days; roseola not observed; diarrhoea during the third and fourth weeks. Patient presented the facial appearance of congenital syphilis, but no other evidence of the disease was found about the body. The younger sister (Case 95) looked quite healthy in this respect. Discharged January 22nd.

CASE 111.—H. H., æt. 6, male, admitted November 12th (eighth day of illness). A mild attack; duration fifteen days. Highest temperature 102.4°; bowels constipated; spleen enlarged. Father also treated in hospital (Case 109). Discharged January 3rd.

CASE 112.—M. M., æt. 10, female, admitted November 14th (seventh day of illness). Probably a case of typhoid; mild attack; duration thirteen days. Highest temperature 102°; bowels constipated. Brother was treated in hospital (Case 132). Discharged December 28th.

CASE 113.—M. S., æt. 8, female, admitted November 15th (ninth day of illness). It is very doubtful if this was a case of typhoid; illness, which began with abdominal pain and vomiting, ran a course of eighteen days. Highest temperature 102.4°. On admission, there were physical signs of pneumonia at the right apex; pulse and respirations rapid; patient was

very pale; a little diarrhoea on the twelfth day of illness (stools not typical of typhoid) followed by constipation. Discharged January 3rd.

CASE 114.—J. W., æt. 37, male, admitted November 15th. Illness probably due to chronic alcoholism and not to typhoid. Discharged December 8th.

CASE 115.—L. B., æt. 8, female, admitted November 17th (eleventh day of illness). This was probably not a case of typhoid. Temperature not above 100° after admission; mouth in a condition of ulcerative stomatitis. Treated with formalin mouth-washes. Good recovery. Discharged January 1st.

CASE 116.—M. L., æt. 15, female, admitted November 17th (eighth day of illness). A severe attack with two relapses. Highest temperature during primary attack 104·8°; duration twenty-eight days; roseola not observed; spleen not palpable; diarrhoea at end of second week, after the administration of an enema to relieve constipation; about half-ounce of blood passed in stool on twenty-fourth day. Temperature reached normal on twenty-eighth day. A relapse set in on the following day with a sudden rise of temperature from 99° to 104°, it having been below 99·2° for more than thirty-six hours previously (Chart II.). It reached 105° three days later. After a gradual deferescence temperature again reached normal on the fifty-third day of illness (twenty-fifth day of relapse), and after four days' apyrexia, another slight relapse occurred lasting fifteen days. She made a good recovery, and was discharged on February 26th.

CASE 117.—S. B., æt. 46, male, admitted November 17th (? thirty-fifth day of illness). Patient had not been feeling well for five weeks before admission. He took to his bed on November 4th, and called in a doctor for the first time on November 6th. He had some diarrhoea on November 11th, also headache, but temperature was very little raised. The patient had been nursing his son with typhoid until the latter was admitted into the hospital on October 2nd. No other member of the family had it. After admission there was no rise of temperature; tongue was much furred, and patient felt weak; bowels constipated; spleen not palpably enlarged; no roseola observed. It is very doubtful if this was a case of typhoid; probably it was not. Discharged January 1st.

CASE 118.—G. W., æt. 6, male, admitted November 24th (fourth day of illness). Probably an abortive case of typhoid; duration eight days; tongue coated with white fur. Highest temperature after admission 101·6; bowels slightly constipated; no rash observed. Discharged January 12th.

CASE 119.—J. W., æt. 5, male, admitted November 27th (fifteenth day of illness). On admission convalescent; temperature 98·4°. Illness commenced with headache and diarrhoea. There had been no other case of typhoid in the house previously. Patient's mother had, however, been nursing two cases of typhoid at another house. At the same time she used to prepare the food for her children, and this is possibly how infection was conveyed. Discharged January 5th.

CASE 120.—B. T., æt. 19, female, admitted Nov. 29th. Probably not a case of typhoid; patient had been working at the Emergency-Laundry since the beginning of October. She took to her bed five days before admission. She was said to have been looking ill for several days before she kept her bed, and complained of headache. Temperature not above 99° after admission; slow pulse; bowels constipated; no roseola; spleen not palpably enlarged. Discharged January 3rd.

CASE 121.—G. B., æt. 12, male, admitted December 6th (fifteenth day of illness). Correctness of diagnosis of typhoid a little doubtful; convalescent on admission. On December 2nd, three days before admission, a scarlatiniform rash appeared, first on inner side of each thigh, afterwards it spread all over abdomen, back, and neck. When admitted it was found to consist of small maculæ of bright red colour, which in places had become confluent; it did not itch, and was not followed by any marked desquamation; no tonsillitis; it disappeared on December 7th. Glycerine enemata had been administered before admission into hospital. Later there was a small patch of tinea circinata on the face. Discharged January 11th.

CASE 122.—H. F., æt. 6, male, admitted December 6th (fourteenth day of illness). A rather severe case on account of lung complications; duration twenty-three days. Highest temperature 104.2° ; spleen much enlarged; diarrhœa during the second and third weeks; bronchitis; physical signs of a patch of broncho-pneumonia just above cardiac area on December 10th; roseola not observed. Discharged January 26th.

CASE 123.—D. G., æt. $6\frac{1}{2}$, female, admitted December 6th (twelfth day of illness). Convalescent on admission; temperature never above 99.4° during patient's stay in hospital; correctness of the diagnosis of typhoid on which she was admitted, doubtful. On December 7th, the day after admission, erythema and urticaria appeared all over the body as well as on limbs. It disappeared after five days. She was sent to a convalescent home on January 12th. Less than a week after she left the hospital she contracted a severe attack of diphtheria, from which she died on January 22nd.

CASE 124.—H. C., æt. 5, male, admitted December 14th (seventeenth day of illness). Temperature was not above 100° after admission to hospital; no roseola observed; spleen not palpably enlarged; it was probably a case of typhoid, but patient was almost convalescent when admitted.

CASE 125.—W. H., æt. 7, male, admitted December 18th. This patient was discharged five days after admission, as he was found to be suffering from whooping-cough; the illness, which had been of about five weeks' duration, was probably due to chest complications of this disease; as he had not been living in Maidstone for seven weeks before the illness commenced, it is probable that he was not exposed to the infection of typhoid.

CASE 126.—E. F., æt. 21, female, admitted December 18th (eighth day of illness). A rather mild attack; duration sixteen days; highest temperature 103.4° . On admission teeth covered with sordes; mouth and tongue very dry; insomnia; roseola present; spleen not palpable; bowels constipated; she vomited several times; menstruation occurred on the eighth day of illness; good recovery. Discharged January 29th.

CASE 127.—E. W., æt. 37, female, admitted January 2nd (sixteenth day of illness). This patient, a nurse, was attending patients at their homes, from one of whom she most probably contracted the disease. She had been troubled with diarrhœa during the earlier part of the week before Christmas. She then felt better again for a few days, until Christmas Eve, when she had most severe headache, chiefly in the occipital region; pains in the limbs and back; she was sick several times. Patient took to her bed two days before admission. She had a severe attack; duration thirty days. Highest temperature 103.8° ; roseola present during the third week; a good deal of diarrhœa during the third and fourth weeks, with tympanites; spleen not

palpable; tongue remained fairly clean throughout illness, and was red; she commenced to menstruate four days after admission; retention of urine for a month commencing January 8th, necessitating the use of a catheter two or three times daily. There was a considerable amount of albumen in the urine during febrile part of illness, and it was also present in smaller quantities for a few days after temperature had become normal; afterwards it quite disappeared. There was no oedema; on an average forty ounces of urine was passed per diem; she stated that she had had scarlatina with nephritis when about five years old; it was at first feared that this large amount of albumen was due to nephritis; however, as it disappeared completely during convalescence, and in the absence of other symptoms, it must be looked upon as febrile albuminuria. There was much vulvar irritation, accompanied with some superficial ulceration on admission which proved a most painful complication; it lasted almost throughout illness, but was much relieved by treatment with sedative ointments. On the twenty-first day of illness, patient complained of pain on deglutition: there was tenderness and a little thickening over right ala of thyroid cartilage; a few days later voice was rather hoarse; the condition was evidently due to slight perichondritis; it cleared up without suppuration. *Tender toes.*—During the third and fourth weeks of illness patient complained of great sensitiveness of the tips of toes, inasmuch as she could not bear the weight of the bedclothes on them. There was tenderness along the course of nearly all the nerve trunks. No paralysis. Good recovery. Discharged February 27th.

CASE 128.—A. R., æt. 29, male, admitted January 4th (tenth day of illness). Patient probably contracted the disease through nursing typhoid cases. A rather mild attack; highest temperature 103°; duration nineteen days; roseola present; spleen not palpable; bowels constipated. He had been subject to epileptic fits since he was sixteen years old, the first being brought about by a shock when he was attending an inquest. He had had only one fit during the twelve months previous to this illness, but had two severe fits just as convalescence was commencing. Good recovery. Discharged February 14th.

CASE 129.—J. R. I., æt. 2½, male, admitted January 8th (? Twenty-fifth day of illness). This patient was convalescent on admission, and at the parent's request, was discharged two days later.

CASE 130.—F. L., æt. 16, male, admitted January 8th (fourteenth week of illness). This patient was admitted to the hospital because he was being improperly nursed at home. The greater part of his illness occurred before admission. His temperature-chart shows four periods of pyrexia of twelve, twenty-eight, fourteen, and ten days' duration respectively, broken by apyrexial intervals of three, eight, and fourteen days. Highest temperature recorded 105.2°. Periostitis of right tibia, seven weeks after temperature had become normal. Discharged February 14th.

CASE 131.—A. R., æt. 29, female, admitted January 15th (seventeenth day of illness). Disease was probably contracted from her sister who had been ill with typhoid in the same house. Patient had a moderately severe attack, with mild relapse; highest temperature, 104°; duration of primary attack fifty-four days; during the last sixteen days of this period the temperature was not above 100°, but it did not settle down to normal; tongue remained furred; she was kept on low diet. Roseola very profuse; spleen much enlarged;

diarrhœa during the third and fourth weeks; some delirium; strange delusions as convalescence was approaching. After a fourteen days' apyrexial interval, a mild relapse set in with slight headache, feeling of chilliness, and rise of temperature; spleen increased in size, but no fresh spots appeared. Temperature became normal again on the twelfth day. She was discharged on March 28th.

CASE 132.—J. M., æt. 6, male, admitted October 7th (thirteenth day of illness). A mild attack; duration sixteen days. Highest temperature after admission 101.2° ; roseola present; spleen enlarged; bowels constipated; slight bronchitis. Discharged November 20th.

CASE 133.—G. D., æt. 36, male, admitted October 7th (eighth day of illness). A moderately severe attack; duration eighteen days. Highest temperature 104° ; roseola not observed; spleen not palpably enlarged; bowels constipated; slow pulse during convalescence. Discharged November 22nd.

CASE 134.—C. H., æt. 14, male, admitted October 7th (twenty-third day of illness). A fairly severe attack; duration thirty-two days. Highest temperature after admission 102.8° ; delirium; roseola present; bowels constipated; slow pulse during convalescence. Discharged November 20th.

CASE 135.—C. R., æt. 21, male, admitted October 7th (eighth day of illness). A mild attack; duration eighteen days. Highest temperature 104° ; roseola present; spleen palpably enlarged; slow pulse during convalescence. Discharged November 22nd.

CASE 136.—F. S., æt. 32, male, admitted October 7th (twelfth day of illness). A moderately severe attack; duration thirty-two days. Highest temperature 104° ; roseola present; bowels constipated; teeth covered with sordes on admission. On October 18th there was a thick yellow urethral discharge, which probably accounted for a rise of temperature on the twenty-ninth and thirtieth days of illness. Patient had had gonorrhœa some time previously. It ceased in the course of a few days under treatment. Discharged December 4th.

CASE 137.—G. K., æt. 9, male, admitted October 7th (eighth day of illness). A moderately severe attack. Highest temperature 103.4° ; duration twenty-four days; roseola present; spleen palpably enlarged; slight bronchitis; bowels generally constipated; a little diarrhœa on two occasions. Discharged December 4th.

CASE 138.—W. C., æt. 9, male, admitted October 7th (fifth day of illness). A moderately severe case; duration twenty-one days. Highest temperature 103.4° ; there were several rises of temperature after the twenty-first day of illness, probably due to constipation; roseola present; spleen palpably enlarged. Discharged December 17th.

CASE 139.—A. D., æt. 14, male, admitted October 7th (seventh day of illness). A rather mild case; duration twenty-seven days. Highest temperature 103.2° ; roseola present; bowels constipated. On October 31st (four days after temperature had become normal) an erythematous blush appeared on chest and abdomen; it was most marked over the side of chest on which patient had been lying, and was bright scarlet in colour; it disappeared in the course of twenty-four hours and was followed by desquamation. Discharged December 22nd.

CASE 140.—W. F., æt. 11, male, admitted October 7th (eighth day of illness). A moderately severe attack; duration twenty-two days. Highest

temperature 105.4° ; roseola present; spleen palpably enlarged; a little diarrhoea during the second week followed by constipation. On October 18th there was an urticarial eruption over bony prominences of face. On the following day the rash looked much like measles, whilst erythema and urticaria appeared on arms and body; an enema saponis had been given on the morning of this day. There was general desquamation at the end of October. Several slight rises of temperature after the twenty-second day of illness; these were probably not due to relapse. Discharged December 22nd.

CASE 141.—W. V., æt. 12, male, admitted October 7th (eighteenth day of illness). A moderately severe attack; duration thirty-one days. Highest temperature 103.6° ; roseola present; spleen palpably enlarged; bowels constipated. Periostitis of coracoid process occurred eight days after convalescence had commenced, with rise of temperature (once reaching 101°) for six days. On November 16th (seventeen days after convalescence had commenced) there was periostitis of right radius, with rise of temperature for fifteen days; no signs of relapse. Stay in hospital was much prolonged by post-typhoid rises of temperature of doubtful cause. Discharged January 20th.

CASE 142.—E. T., æt. 16, male, admitted October 7th (tenth day of illness). A severe attack; duration thirty days. Highest temperature 104° ; roseola not observed; bowels constipated; much delirium with hallucinations and delusions; at times he talked of poaching expeditions, at other times he thought he was selling dogs, chickens, &c.; this made him exceedingly difficult to manage; he became rational about the last week in November, when he remembered little of what he had said or done. He had a slight relapse thirteen days after temperature had become normal, which lasted for eight days. An abscess in the neck was opened on November 21st, when a quantity of caseous pus was scraped out; the abscess apparently arose in a lymphatic gland. The pus-serum gave a positive reaction with the "clumping test;" no pyogenic organisms were found in the pus. Discharged January 3rd.

CASE 143.—F. W., æt. 21, male, admitted October 8th (sixth day of illness). A severe attack. Highest temperature 104.4° ; roseola present; spleen enlarged; bowels rather loose at the commencement of second week of fever. On October 13th (eleventh day) there was much tympanites and pain in abdomen. On October 14th patient had retention of urine: a catheter was passed and 20 ounces was drawn off. This retention continued, and there was much difficulty in passing catheter, as urethra was very sensitive. On October 17th at 2.30 a.m., 15 ounces of bright red blood was passed, mixed with very offensive faecal matter. An ice bag was applied to abdomen, and Spirit. Terebinth. and Tr. Opii given by the mouth. Abdomen was exceedingly tender, and there was pain in the right iliac fossa. Moderate distension. At 10 p.m., temperature 103° , pulse 124, respiration 28. During the following night patient was very restless, and towards morning repeatedly vomited greenish-black fluid. At 2 a.m., temperature 104.4° ; at 6 a.m., temperature 103.2° ; respiration 50; pulse very rapid. He rapidly sank and died at 10.30 a.m. (sixteenth day of the fever). There is little doubt that perforation had taken place. An autopsy was not allowed.

CASE 144.—W. A., æt. 28, male, admitted October 8th (sixth day of illness). A moderately severe attack; duration thirty-six days. Highest temperature 103.6° ; roseola present; spleen palpably enlarged; bowels

constipated; some bronchitis. On twenty-first and twenty-second days of fever irregular patches of erythema appeared on extensor surfaces of arms and thighs; an enema saponis had been administered on the twentieth day. Discharged December 23rd.

CASE 145.—W. T., æt. 17, male, admitted October 9th (eighth day of illness). A mild attack; duration seventeen days. Highest temperature 103.2° ; roseola present; spleen not palpably enlarged; bowels slightly constipated. Discharged November 22nd.

CASE 146.—A. B., æt. 6, male, admitted October 9th (twenty-fifth day of illness). Very ill before admission; duration of fever thirty-five days. Highest temperature 102.2° ; roseola present; bowels constipated; superficial bleeding from lips and nose; some eczema about face; several irregular rises of temperature after the thirty-fifth day probably due to constipation. Small subcutaneous abscess behind mastoid on October 28th. Discharged December 18th.

CASE 147.—H. M., æt. 17, male, admitted October 9th (third day of illness). A rather severe attack; duration thirty-one days. Highest temperature 105° ; roseola profuse; spleen slightly enlarged; bowels generally constipated, a little diarrhoea on several occasions; much vomiting; delirium; slight bronchitis; albuminuria during height of illness. Periostitis of clavicle on November 9th (three days after convalescence had commenced) without rise of temperature. Discharged January 1st.

CASE 148.—A. A., æt. 13, male, admitted October 9th (ninth day of illness). A severe attack with relapse; duration of primary attack twenty-five days. Highest temperature 104.6° ; roseola present; spleen not palpably enlarged; bowels constipated; much delirium; severe bronchitis, and hypostatic congestion of bases of lungs. A relapse set in nine days after temperature had become normal; duration twenty-eight days. Highest temperature 104.2° ; a little diarrhoea; relapse almost as severe as primary attack. He was in a very emotional condition during the active stage of his illness, and remained in the same condition for three or four weeks after the temperature had become normal. Discharged January 20th.

CASE 149.—J. J. W., æt. 37, male, admitted October 18th (tenth day of illness). A moderately severe attack; duration twenty days. Highest temperature 104.8° ; roseola present; spleen not felt; a little diarrhoea. On the twenty-second day—that is two days after the temperature had been normal—temperature suddenly rose to 103° ; it fell to normal on the twenty-fifth day and did not rise again; there were no abdominal symptoms. Discharged January 1st.

CASE 150.—M. W., æt. 25, female, admitted October 9th (tenth day of illness). A moderately severe attack; highest temperature 103.2° ; duration twenty-nine days; roseola very profuse; bowels constipated; spleen not palpable; epistaxis on the third day. Discharged November 27th.

CASE 151.—E. H., æt. 38, female, admitted October 9th (fourth day of illness). Temperature normal on admission; a mild attack followed by a mild relapse; duration of fever of first attack (whilst in hospital), nineteen days; highest temperature 103° ; roseola profuse; bowels constipated; spleen enlarged. A relapse set in after eight days' apyrexia, lasting ten days; a fresh crop of spots appeared; bowels constipated. Complication:—Abortion (at the second month) occurred on the seventh day of illness (third day of pyrexia). Discharged December 18th.

CASE 152.—E. G., æt. 19, female, admitted October 9th (fifteenth day of disease). A moderately severe attack; duration twenty-two days; highest temperature 102.2° ; roseola not observed; bowels constipated; spleen not felt; retention of urine from the 18th to 24th days of illness; catheter passed. After twenty-four days' apyrexia, a relapse set in, with headache and rise of temperature; duration fifteen days; a fresh crop of spots appeared; spleen increased in size; bowels constipated; highest temperature 103° ; eleven days after temperature had become normal it was again raised for five days; highest point, 101° ; no abdominal symptoms; probably not a relapse. Discharged January 12th.

CASE 153.—M. N., æt. 3, male, admitted October 10th (fifteenth day of illness). This was probably not a case of typhoid; no rise of temperature after admission; evidence of rickets. Discharged November 23rd.

CASE 154.—G. M., æt. 4, male, admitted October 10th (fourth day of illness). A mild case; duration fourteen days; highest temperature 102.4° ; roseola not observed; spleen enlarged; bowels constipated; some tympanites. After being removed to a transfer-hospital he had diphtheria, from which he recovered. Discharged January 31st.

CASE 155.—E. K., æt. 47, female, admitted October 10th (fifteenth day of illness). A severe attack; duration forty days; highest temperature 103.8° ; roseola present as late as the fortieth day of illness; diarrhœa; slight hæmorrhage (clots only) on the twenty-first and thirtieth days of illness. Discharged December 18th.

CASE 156.—A. R., æt. 12, female, admitted October 10th (seventh day of illness). A moderately severe case; duration sixteen days; highest temperature 103.6° ; roseola present; spleen palpably enlarged; bowels slightly constipated; a little bronchitis; small abscess in scalp, probably not due to typhoid. Discharged November 20th.

CASE 157.—E. B., æt. 10, female, admitted October 10th (sixth day of illness). A mild attack; duration twelve days. Highest temperature 102° ; roseola present; bowels constipated; spleen not palpable. Discharged November 20th.

CASE 158.—M. S., æt. 11, female, admitted October 10th (seventh day of illness). A moderately severe attack; duration twenty-seven days. Highest temperature 104.6° ; roseola present; spleen enlarged; a little diarrhœa during the end of the second and the beginning of the third weeks; constipation later; a little bronchitis; epistaxis on the eighth day. Discharged December 23rd.

CASE 159.—A. W., æt. 14, female, admitted October 11th (fifth day of illness). A mild attack; duration twelve days. Highest temperature 103.2° ; roseola present; spleen not palpable; bowels constipated. Discharged November 17th.

CASE 160.—M. W., æt. 17, female, admitted October 11th (twenty-sixth day of illness). A moderately severe attack; duration thirty-nine days. Highest temperature 104.6° ; roseola present; spleen not palpably enlarged; a little bronchitis; slight diarrhœa at times. She passed about $\frac{1}{4}$ -oz. of blood on October 15th (thirtieth day of disease). Discharged December 18th.

CASE 161.—B. B., æt. 9, female, admitted October 11th (ninth day of illness). This patient was mentally deficient. A rather mild attack; duration twenty-five days. Highest temperature 104° ; roseola present;

spleen not palpably enlarged; bowels a little constipated. Discharged December 15th.

CASE 162.—E. P., æt. 33, female, admitted October 11th (eleventh day of illness). There was a little doubt as to the correctness of the diagnosis on which patient was admitted. She stated that she had been feeling ill for a long time past, but had kept her bed since October 1st only; there was no rise of temperature after admission; pulse slow; veins of right leg thrombosed; several small ulcers over shin of short duration; bowels constipated. Discharged December 13th.

CASE 163.—L. M., æt. 25, female, admitted October 11th (sixth day of illness). A moderately severe attack; duration twenty-eight days. Highest temperature 104.4° ; roseola present; bowels slightly constipated; a little bronchitis. Discharged December 13th.

CASE 164.—S. B., æt. 7, female, admitted October 12th (fifth week of illness). Almost convalescent on admission; temperature not above 100° ; duration probably about five weeks. Discharged November 8th.

CASE 165.—E. B., æt. 5, female, admitted October 12th (fifth week of illness). Temperature on admission 101° ; fell to normal on the same evening. Duration of fever probably about five weeks. Discharged November 8th.

CASE 166.—M. C., æt., 26, female, admitted October 12th (fourteenth day of illness). A mild attack; duration twenty days. Highest temperature 103.4° ; roseola present; bowels constipated. On October 18th, the following note was made: "Fading purplish punctate rash over lower part of chest and abdomen." An enema had been administered two days previously. Discharged November 17th.

CASE 167.—M. B., æt. 13, female, admitted October 12th (eighth day of illness). A moderately severe attack; duration twenty-two days. Highest temperature 103.4° ; roseola present; bowels constipated; spleen not palpably enlarged; she passed a few clots of blood in stool on October 17th (thirteenth day of fever). Discharged January 11th.

CASE 168.—A. V., æt. 6, female, admitted October 12th (eighth day of illness). A mild attack; duration fourteen days. Highest temperature 102.8° ; roseola not observed; spleen not palpably enlarged; bowels constipated. Discharged December 16th.

CASE 169.—E. S., æt. 9, female, admitted October 12th (twenty-seventh day of illness). A long and severe attack; duration fifty-one days. Highest temperature 103.8° ; roseola present; bowels constipated; a little bronchitis; there was a slight rise of temperature for several days after an interval of six days' apyrexia; this was probably not a relapse. In the previous August this patient had a bad attack of diarrhoea, for which she was treated at the local hospital. Discharged January 26th.

CASE 170.—H. K., æt. 14, female, admitted October 13th (tenth day of illness). A moderately severe attack; duration twenty days. Highest temperature 103.2° ; roseola present; spleen not palpable; bowels slightly constipated. Discharged December 18th.

CASE 171.—E. B., æt. 11, female, admitted October 13th (tenth day of illness). A very severe attack with relapse; duration of primary attack forty-two days; roseola present; spleen enlarged; bowels constipated; some bronchitis. On November 2nd a scarlatiniform rash appeared all over the body,

but was most profuse on back ; there were also some small red papules on legs and arms ; an enema had been administered on the previous day. After nine days' apyrexia a relapse set in lasting sixteen days, a fresh crop of spots appeared, and there was some bronchitis ; bowels were constipated ; relapse not quite so severe as primary attack. Discharged January 29th.

CASE 172.—S. W., æt. 4, male, admitted 15th October (fourth day of illness). A moderately severe attack ; duration thirty days. Highest temperature 105° ; roseola present ; spleen not palpable ; bowels constipated ; a little bronchitis. On October 21st (tenth day of illness) at 2 a.m., patient had a rigor (Chart VIII.) ; temperature rose to 104.8° ; pulse 156 ; it was followed by a gradual fall of temperature to subnormal at 10 p.m. on the same day, and a gradual rise to 102.2° on the following day. The bowels had not been opened for more than three days ; an enema was given shortly after the rigor with a good result. Good recovery. Discharged December 15th.

CASE 173.—L. L., æt. 16, female, admitted October 19th (twenty-first day of illness). A very severe case, with an almost continuous high temperature (generally between 103° and 104°) for the first five weeks, and ending by crisis on the thirty-eighth day. Highest temperature recorded 105° ; pulse-rate never above 128 ; much headache and vomiting during the earlier part of this period ; and diarrhoea throughout. Roseola present. There was much bronchitis, and although no physical signs of pneumonia were discovered, it is highly probable from her symptoms that this complication occurred during the fifth week, which would account for the termination of the pyrexia by crisis. After a few hours' apyrexia, temperature gradually rose again, reaching 102.6° on the fourth day ; it ran a course of thirty-eight days, with morning remissions. Bowels were constipated during nearly the whole of this period, and patient suffered little, often asking for more food. It ought undoubtedly to be considered a relapse. On December 16th (three days after the termination of the relapse), about 2 p.m., patient was suddenly seized with pain in the right iliac region ; her temperature, which was then 97.6° , gradually rose until 2 p.m. the following day, when it reached 103.6° (Chart III.) ; pulse was increased in frequency ; there was tenderness in the right iliac region, and a little rigidity of the abdominal wall ; legs were drawn up in the bed ; she was several times sick. The bowels had been opened twice slightly on the previous day, but as the motions were much constipated an enema was given on the morning of December 16th with a good result. We had every reason to fear that perforation had taken place. Small doses of Tr. Opii were given frequently ; also small quantities of champagne, and patient was kept as quiet as possible, all unnecessary movement being avoided. There was a marked improvement after thirty-six hours, and temperature remained normal after December 21st. It seems highly probable that the condition was due to local peritonitis, but whether it was brought about by a small perforation which subsequently healed, or by extension of inflammation from an ulcer, must remain uncertain. Nothing like an inflamed appendix cæci could be felt. She made a good recovery, and was discharged on February 1st.

CASE 174.—E. C., æt. 7, female, admitted October 19th (tenth day of illness). This patient was said to have been ill for only ten days before admission, but it was probably much longer. She was convalescent when admitted, but after being sent to the Transfer-hospital she suffered with a

sore throat, probably diphtheria, which much prolonged her stay in the hospital. Discharged February 18th.

CASE 175.—E. S., æt. 13, female, admitted October 19th (fifteenth day of illness). A moderately severe attack; duration twenty-nine days. Highest temperature 103.6° ; bowels constipated. Discharged December 17th.

CASE 176.—J. S., æt. 4, male, admitted October 19th (eleventh day of illness). A moderately severe attack; duration twenty-two days. Highest temperature 104.2° ; roseola present; spleen very much enlarged; bowels constipated. Discharged November 6th.

CASE 177.—N. H., æt. 16, female, admitted October 19th (twenty-ninth day of illness). A mild attack. This patient was admitted as a case which had relapsed. According to the temperature chart the relapse commenced on October 11th; she was therefore taken into the hospital on the ninth day of relapse; duration fourteen days. Highest temperature 104.4° ; roseola present; bowels constipated. Discharged January 3rd.

CASE 178.—L. K., æt. 13, female, admitted October 19th (eighth day of illness). A rather mild case; duration seventeen days. Highest temperature 102.4° ; roseola present; bowels constipated. Discharged December 18th.

CASE 179.—S. L., æt. 44, female, admitted October 19th (ninth day of illness). This patient had kept her bed for two days only before admission. The pyrexia ran a course of forty-five days, but it is probable that during the last fortnight of this period the rise of temperature was due to complications and not directly to typhoid. There was moderate pyrexia during the first three weeks of illness; temperature was higher during the fourth week; the highest point reached was 103.4° . Much headache and vomiting during the second week. During the third week there were symptoms of neuritis; patient complained of numbness, tingling and severe pain in upper extremities; there was tenderness along the course of the nerve-trunks, and pain on making pressure over the cutaneous nerves between the metacarpal bones; there was diminution of tactile sensibility of hands and arms; the fingers were pale; hands seemed weak, but it was difficult to ascertain if the apparent weakness was due to actual loss of power in muscles or to the fear of pain in grasping objects firmly; no obvious wasting of muscles; knee-jerks present. These symptoms disappeared in the course of three or four weeks. On the twenty-eighth day of illness, thrombosis of left saphenous vein set in with pain and tenderness over the course of the vein and rise of temperature. Two days later patient had a rigor, and temperature reached 104.8° (Chart XI.); the pyrexia gradually subsided until the afternoon of the thirty-sixth day when another rigor occurred, and temperature rose to 104.6° ; temperature again gradually fell until it reached normal on the forty-second day. On the forty-third day it rapidly rose again to 104° , and as rapidly subsided. On the following day patient said she felt something break in her throat, and shortly afterwards spat out about half an ounce of pus. There was no external evidence of the formation of an abscess, and no abscess opening could be seen from mouth. On December 1st she complained of pain in right side, and a pleuritic rub was heard at the base of right chest in the mid-axillary line; there was a slight rise of temperature. Bowels were constipated throughout illness. Her stay in the hospital was much prolonged owing to the thrombosis. Her two children (Cases 173 and 183) were treated in the same hospital. She made a good recovery, and was discharged on February 23rd.

CASE 180.—E. P., æt. 8, female, admitted October 19th (tenth day of illness). A mild case almost convalescent on admission; duration of fever thirteen days; spleen much enlarged. Discharged January 20th.

CASE 181.—E. J. A., æt. 14, female, admitted October 19th (twenty-first day of illness). A severe attack; duration fifty days. Highest temperature 103.6° ; bowels opened fairly regularly during the earlier part of the attack; later there was constipation. Vomiting during the fourth week. Discharged December 17th.

CASE 182.—A. C., æt. 16, female, admitted October 19th (ninth day of illness). This patient was practically convalescent on admission; previous chart showed temperature of 102.6° on October 11th, which gradually fell to normal on October 15th. Discharged January 20th.

CASE 183.—L. L., æt. 5, male, admitted October 19th (twenty-seventh day of illness). This patient was practically convalescent on admission; temperature 99.4° . On October 28th (nine days later) an abscess in ischio-rectal fossa was opened under an æsthetic; it contained foul pus. There was a rise of temperature for three days previously. The wound healed rapidly. Discharged December 4th.

CASE 184.—R. B., æt. 9, male, admitted October 19th (eighth day of illness). A very severe case from the first. Highest temperature 105.2° ; roseola present; spleen enlarged; diarrhœa throughout illness; during the fortnight previous to his death he frequently passed his evacuations in the bed. Bronchitis occurred early in the attack, and was accompanied with dyspnœa and cyanosis. Pulse was very rapid until the twenty-second day, when, after a few doses of Tr. Digitalis, its rate was reduced, generally varying from 80 to 100; the respirations, however, remained rapid, and indeed became more rapid; there were physical signs of gradually increasing consolidation at the base of left lung. Cyanosis was often extreme whilst pulse was good; much relief was afforded by inhalations of oxygen. He died on November 13th (the thirty-third day), death apparently arising from the condition of his lung and the exhaustion from diarrhœa.

CASE 185.—A. S., æt. 44, male, admitted October 19th (ninth day of illness). Patient had been a very heavy drinker. On admission temperature 103.4° ; pulse 86; frequent vomiting; roseola present. During the end of the second week bowels were very loose. On the thirteenth day he passed a little blood in a stool. On the following day symptoms of peritonitis appeared; there was much tympanites and tenderness of abdomen; eyes were sunken. On the fifteenth day, abdomen was hyper-resonant all over, the liver dulness being completely obliterated; vomiting; pulse and respirations getting more rapid. At 10 p.m. temperature 100.8° . On October 26th (the sixteenth day), at 1 a.m.; temperature 108° (Chart IV.); it was reduced to 101° by rubbing the body with ice. He died about three hours later. Perforation had undoubtedly taken place.

CASE 186.—H. S., æt. 12, male, admitted October 19th (tenth day of illness). A rather mild attack; duration seventeen days; highest temperature 102.8° ; roseola present; spleen much enlarged; bowels constipated. Discharged December 13th.

CASE 187.—W. S., æt. 8, male, admitted October 19th (tenth day of illness). A moderately severe attack; duration nineteen days; highest temperature 104° ; roseola present; bowels fairly regular; delirious at night during height of illness. Discharged December 11th. His father died in hospital (Case 185).

CASE 188.—P. L., æt. 8, male, admitted October 19th (? seventh day of illness). This patient was almost convalescent on admission, and had probably been ill more than seven days; spleen enlarged. Discharged December 14th.

CASE 189.—A. T., æt. 33, male, admitted October 19th (fifth day of illness). The history of the duration of illness on admission is probably incorrect, the patient had, no doubt, been ill longer than five days. On admission, temperature 100° ; doubtful rose spots on abdomen; tongue covered with white fur; pulse very slow. Almost convalescent when admitted. Discharged November 22nd.

CASE 190.—W. F., æt. 14, male, admitted October 19th (fourteenth day of illness). Almost convalescent on admission; temperature 99.2° . *Sequela*. Parotitis. On November 17th the right parotid gland was noticed to be swollen; it was not very tender; no redness of skin over it; temperature very slightly raised; it caused patient very little discomfort, and never threatened to suppurate. The swelling continued for six or seven weeks. He was sent to a convalescent home on December 14th.

CASE 191.—A. G., æt. 42, male, admitted October 20th (fourth week of illness). This patient was a cab-driver; he said he had been feeling very ill for a long time before he gave up his work. He became so ill one day when he was driving his cab, that he asked his fare to get upon the box and to drive himself. He had a moderately severe attack; duration ? seven weeks. Highest temperature 103.8° ; roseola present; a little diarrhœa during the second week in hospital. Discharged December 10th.

CASE 192.—E. T. T., æt. 45, female, admitted October 20th (twelfth day of illness). A mild attack. Highest temperature 102° ; duration nineteen days; roseola present; bowels constipated. Discharged December 11th.

CASE 193.—M. P., æt. 11, female, admitted October 20th (ninth day of illness). A rather mild attack; duration twenty-eight days. Highest temperature 104° ; roseola present; bowels a little constipated. This patient was said to have had typhoid eight months previously, and the occurrence was then notified to the M. O. H. Discharged December 18th.

CASE 194.—S. P., æt. 12, male, admitted October 20th (nineteenth day of illness). A moderately severe case; duration ? thirty-eight days. Highest temperature 103.6° ; roseola present; bowels constipated. Discharged December 14th.

CASE 195.—A. D., æt. 8, male, admitted October 21st (twenty-first day of illness). Almost convalescent on admission. Eighteen days after temperature had been normal, it again began to rise and reached 101.2° on the third day; it subsided to normal on the seventh day and again rose on the ninth day. Duration of relapse (including the initial rise of temperature) thirty-one days. Highest temperature 103.4° ; roseola present; spleen much enlarged; slight diarrhœa; severe bronchitis during the third week of relapse. Discharged February 1st.

CASE 196.—J. C., æt. 31, male, admitted October 21st (eleventh day of illness). A moderately severe attack; duration thirty days. Highest temperature 103.6° ; roseola present; a little diarrhœa. Discharged December 23rd.

CASE 197.—C. B., æt. 23, female, admitted October 21st (fifth week of illness). This was probably a case of typhoid, but patient was convalescent on admission. Discharged November 17th.

CASE 198.—A. S., æt. 22, female, admitted October 22nd (? thirty-fifth day of illness). This patient was convalescent on admission; probable duration of attack twenty-eight days. Her temperature chart showed 104.4° to be the highest registered. Discharged November 17th.

CASE 199.—B. B., æt. 11, female, admitted October 22nd (second day of illness). Patient had taken to bed on the day before admission. She had a moderately severe attack; duration twenty-six days; highest temperature 102.2° ; much headache during the first week, when epistaxis also occurred; roseola present; bowels constipated. Discharged December 16th.

CASE 200.—N. F., æt. 10, female, admitted October 23rd (thirtieth day of illness). On admission temperature 99.2° ; she was practically convalescent; patient was taken in because she had a bad home and was being improperly fed. Discharged December 18th.

CASE 201.—H. P., æt. 5, male, admitted October 23rd (seventh day of illness). A moderately severe attack with two slight relapses; duration of primary attack twenty-nine days; highest temperature 104° ; spleen much enlarged; bowels constipated; mild relapse of five days' duration, after a four days' interval of apyrexia; another mild relapse lasting twelve days after two days' apyrexia. Discharged January 12th.

CASE 202.—M. B., æt. 20, female, admitted October 23rd (tenth day of illness). A mild attack; duration seventeen days. Highest temperature 104° ; roseola present; bowels constipated. Discharged December 13th.

CASE 203.—H. C., æt. 35, male, admitted October 23rd (twenty-second day of illness). A severe attack; duration forty-five days. Highest temperature 104.6° ; profuse roseola all over body and arms; slight diarrhœa; much delirium; very sleepless at night; much tympanites. He passed small quantities of blood in the stools on twenty-third and twenty-fourth days of fever; at this period he complained of pain and tenderness of abdomen. On the day before his admission to the hospital he attempted to commit suicide by hanging himself. He made a good recovery. Discharged December 30th.

CASE 204.—F. R., æt. 14, male, admitted October 25th (forty-third day of illness). A record of the course of the temperature before admission was not obtained, but from the history it seemed probable that patient was suffering from a relapse; duration of the whole illness fifty-nine days. Highest temperature after admission 103.8° ; roseola present; slight diarrhœa with very offensive stools; much emaciation. Discharged January 1st.

CASE 205.—A. R., æt. 26, female, admitted October 25th (third day of illness). A rather severe attack; duration twenty-three days. Highest temperature 104.4° ; profuse diarrhœa during first week of stay in hospital. Patient was very melancholy and had delusions during the greater part of her illness; although her mental condition very much improved, there was still depression and fear when she was discharged. On November 24th, ten days after temperature had previously become normal, it again rose (Chart V.), and on the following morning patient complained of severe pain in her abdomen. At 2 p.m., November 25th, temperature 101.6° ; pulse 124; shortly afterwards patient gave birth to a six and a half months' child, which lived about half an hour. At 6 p.m., after the labour, temperature reached

104.6°; pulse 132; respiration 43; Ext. Ergotæ Liq. was given to promote uterine contraction. Temperature gradually fell, becoming normal on November 27th. Patient made a good recovery. Discharged December 22nd.

CASE 206.—M. R., æt. 12, female, admitted October 25th (forty-third day of illness, probably first day of relapse). Duration of relapse? twenty-four days. Highest temperature 104.4°; bowels constipated; patient had a moderately severe attack. Discharged December 24th.

CASE 207.—W. W., æt. 7, male, admitted October 26th (eighth day of illness). A mild case; highest temperature after admission 100.6°; duration of fever ten days; roseola present; bowels constipated. Discharged December 4th.

CASE 208.—A. F., æt. 4, male, admitted October 26th (sixth day of illness). A moderately severe attack; duration of fever nineteen days; highest temperature 103.8°; a little diarrhoea; pulse rapid throughout illness. *Hæmaturia*. On the nineteenth day of illness, when patient's temperature had just become normal he passed a considerable amount of blood in his urine; after allowing the urine to settle in a glass for some time about a quarter of its bulk appeared to be blood; at the same time numerous small subcutaneous hæmorrhages made their appearance about the face and arms. The blood entirely disappeared from the urine in three days; there was no diminution in the quantity of urine passed; and no other symptoms to indicate nephritis. He made a very good recovery. Discharged December 24th.

CASE 209.—C. H., æt. 8, male, admitted October 26th (twenty-fifth day of illness). On admission, temperature 98.6°; he was perfectly convalescent. Discharged December 14th.

CASE 210.—H. H., æt. 35, male, admitted October 27th (thirty-fifth day of illness). Approaching convalescence; duration of illness forty-five days; bowels constipated. Highest temperature after admission 100.6° Discharged December 23rd.

Miniature copies of the temperature charts of all the cases accompanied my report to the Medical Officer of Health.

It would, of course, be both impossible and useless to reproduce all of them here; I have, however, selected portions of the charts of a few cases which appeared to me sufficiently interesting to be worth reproducing.

In the following charts:—E. signifies that an enema was given to open the bowels.

Temperatures taken after patients had been sponged are indicated by outline dots.

CHART I.—Temperature 104° on the first day of a severe relapse
(Case 77).

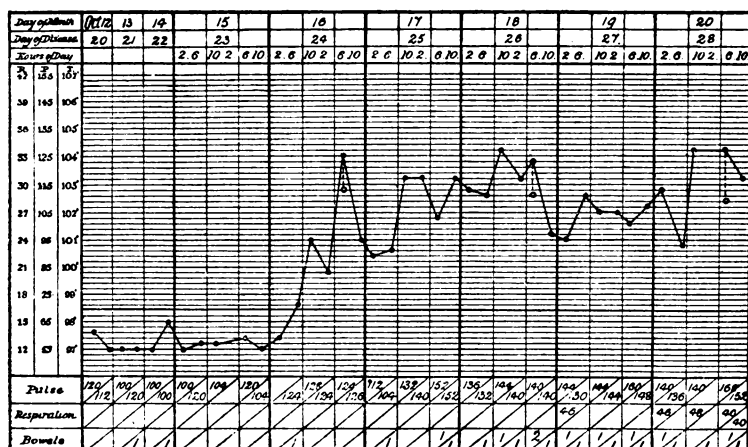
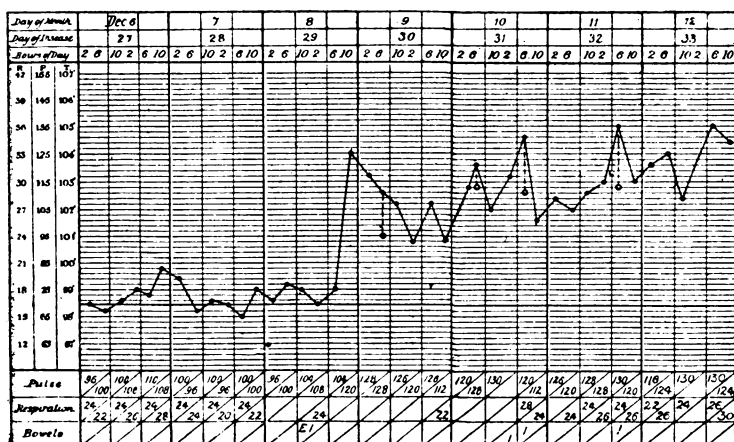


CHART II.—Onset of relapse marked by sudden rise of
temperature to 104° (Case 116).



Days of month		Dec 15					16					17					18					19					20					21				
Days off season		78					79					80					81					82					83					84				
Hours of Day		2	6	10	2	6	10	2	6	10	2	6	10	2	6	10	2	6	10	2	6	10	2	6	10	2	6	10	2	6	10					
R	15.6	107											102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102						
42	145	106											106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106						
36	145	106											106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106						
34	135	105											105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105						
33	125	104											104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104						
30	115	105											105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105						
27	105	102											102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102						
24	88	101											101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101						
21	85	100											100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100						
18	25	90											90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90						
15	06	90											90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90						
12	02	90											90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90						
Pulse	82	80											110	126	122	124	110	104	100	100	100	112	126	108	92	100	94	80	90	110	100	100				
	78	80											100	128	124	120	118	120	114	100	100	110	130	100	92	100	94	80	90	110	100	100				
Respiration															26	30	36	30	28	26	26	26	26	26	26	26	26	26	26	26	26	26				
															30	32	30	26	30	26	26	26	26	26	26	26	26	26	26	26	26	26				
Bowels	1	1											E1															E1				E1				

	Oct 20						21			22			23			24			25			26 THUR DAY		
Day of Month	10						11			12			13			14			15					
Day of Year	208						209			210			211			212			213			214		
Hours of Day	0	2	6	10	2	6	10	2	6	10	2	6	10	2	6	10	2	6	10	2	6	10		
43	135	137																						
39	143	104																						
34	155	105																						
28	125	104																						
30	145	105																						
27	105	107																						
24	98	101																						
21	88	100																						
18	85	99																						
15	86	98																						
11	87	97																						

Sight Remembrance

Pulse	80	90	95	95	92	92	92	92	88	104	88	100	112	94	100	116	126	120
Respiration	34	32	26	32	26	24	24	22	18	32	24	20	26	10	10	28	12	13
Bowls	/					3	2	2		2			3	3	2	3	2	4

CHART V.—Premature labour on the tenth day of convalescence attended with rise of temperature (Case 205).

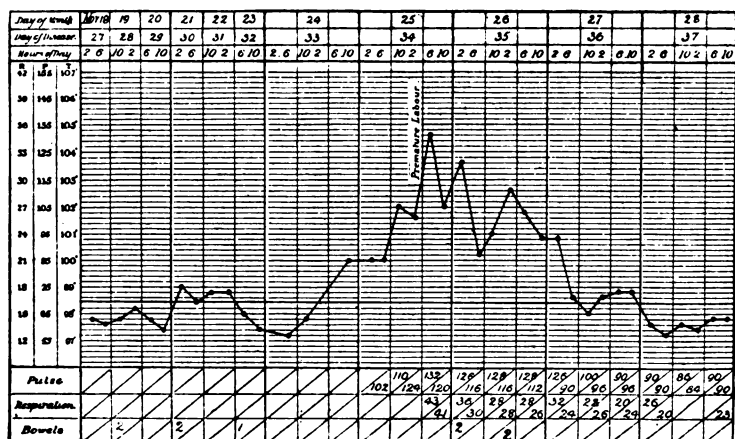


CHART VI.—Thrombosis of left femoral vein: rigor (Case 33).

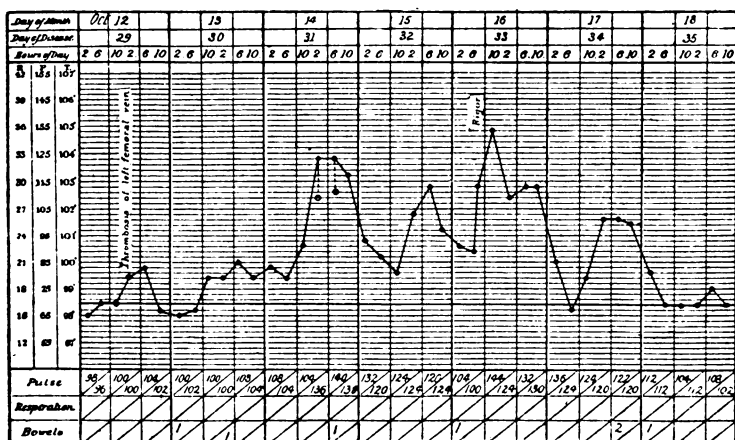


CHART VII.—Rigors and hyperpyrexia following mental worry
(Case 61).

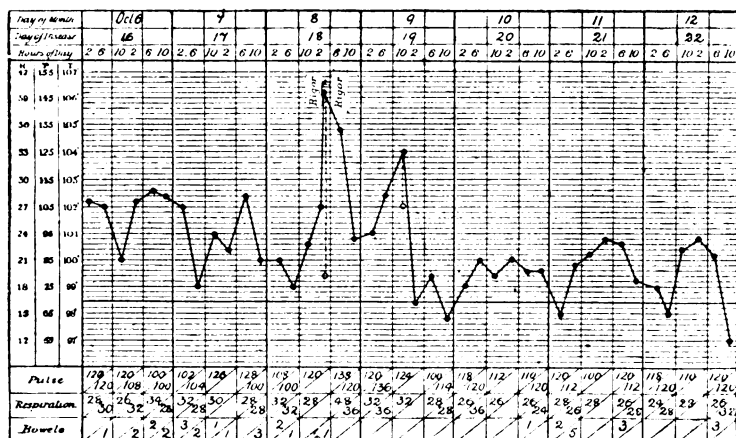


CHART VIII.—Rigor on tenth day of disease (Case 172).

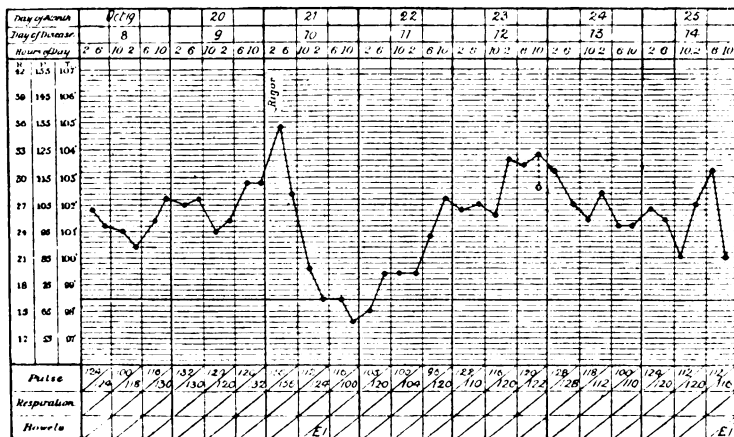
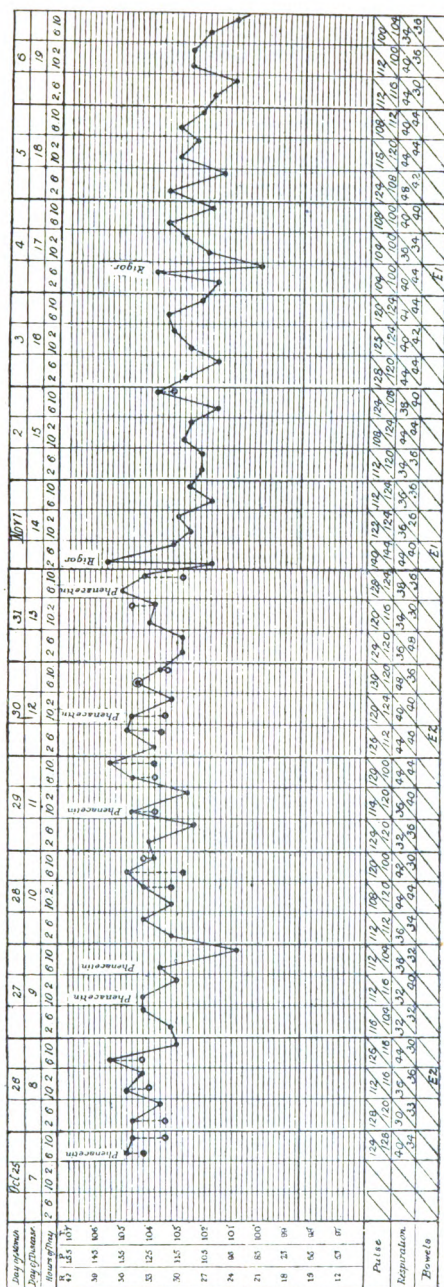
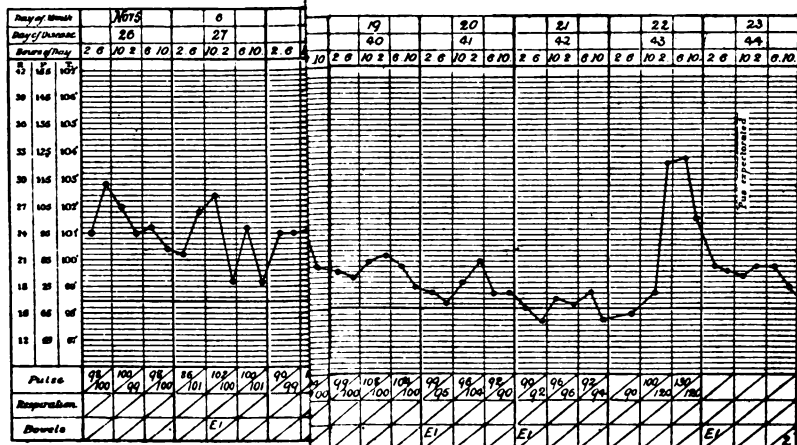
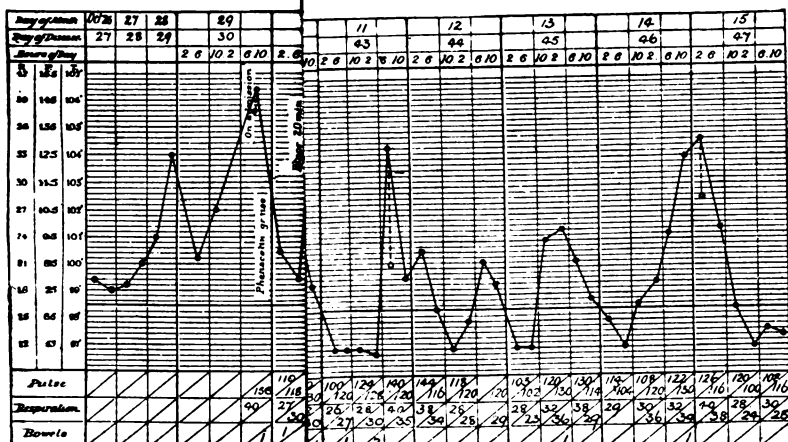


CHART IX.—Rigors on fourteenth and seventeenth days of illness (Case 87).



week (Case 94).



PROJECTING UPPER FRONT TEETH.

By F. NEWLAND-PEDLEY, F.R.C.S.

THERE is a very characteristic deformity of the dental arch affecting the six front teeth, the incisors and laterals especially, which project like the blades of a fan in front of the lower lip, even when the mouth is closed. The upper front teeth overlap and conceal not only the lower front teeth, but in many cases the upper part of their sockets. The lip rests in the space between the two dental arches, and its presence in this site prevents the projecting teeth from falling back into a better position. The lower front teeth, instead of meeting the upper incisors normally, bite upon the necks of the upper teeth close to the gum, and in well-marked cases meet the palate only at some distance behind the teeth. This condition supervenes upon the abnormal eruption of the permanent teeth, and must be distinguished from a somewhat similar deformity that occurs in advancing years when the loss of the back teeth, if not compensated by artificial substitutes, leads to a kind of rodent dentition, and the upper front teeth are gradually loosened, separated and driven forwards until they project in front of the lower lip like small dominoes. In children the simplest form of projecting front teeth is due to the retention of the upper temporary teeth or their roots, and the permanent teeth erupt with increased obliquity in front of the temporary

predecessors. The timely removal of the temporary teeth and the application of gentle digital or mechanical pressure may be all that is required. A high place in the list of exciting causes is generally given to the agency of the lower lip, and certainly the bad habit of constantly biting the lower lip when reading or thinking is capable of producing anterior obliquity of the upper front teeth ; but in the majority of cases the position of the lower lip is the sequel, not the cause of the deformity. An everted eruption of the teeth may be independent of retained temporary teeth or roots, and may occur without assignable cause, as may be seen in any series of models illustrating the early stages of this abnormality. The molars are sometimes short, and if the anterior lower teeth are of normal length, the upper front teeth will be driven forwards in the act of mastication. The shortness of the molars may be attributable to the premature loss of the temporary molars allowing the jaws to approximate too closely, or may be chiefly due to the premature loss of the first permanent molars acting in the same manner. On the other hand, the shortness of the molars may be caused by deficient vertical development of the ascending ramus of the mandible, and this defect may be due to premature extraction of the first permanent molar, which allows the second permanent molar to erupt anteriorly, and may thus limit development of the mandible at the angle. The fan-shaped projection of the upper teeth is occasionally the effect of even arrangement in a series of teeth with crowns too large for the arch in which they are implanted. Thumb-sucking, tongue-sucking, and toe-sucking are always mentioned as possible factors in the production of this deformity. In tongue-sucking the position of the central incisors is chiefly affected, whilst in thumb-sucking the pressure affects a larger number of teeth, and probably modifies the shape of the palatal vault.

The treatment on strictly mechanical lines consists in adapting a regulation- or correction-plate, by means of which pressure can be exerted on the outstanding teeth. The crown of a tooth can gradually be made to move in an arc around the apex of the root which remains practically a fixed point. Even in the simplest

cases time will be required, for any attempt to move the teeth quickly gives pain and produces swelling of the gum, which must be met by temporary removal of the plate; for there is danger that the teeth will remain permanently loose, or that the vitality of the pulp may be lost and the tooth become discoloured.

It will be found that the effect produced by drawing teeth from an oblique to a vertical position is to make them appear longer, and when the upper incisors have been trained inwards they will generally conceal the whole of the crowns of their antagonists. Undoubtedly it is possible to shorten teeth by gradually depressing them in their sockets, and to some extent this may be effected by suitable pressure brought to bear upon them whilst they are in process of being drawn inwards. Faults in the construction of the regulation-plates are the commonest source of failures which are revealed when the case is completed and the use of the apparatus is discarded, for unless due precautions have been taken it will be found that the back teeth no longer meet, and consequently the lower front teeth impinge on the posterior surface of their antagonists, quickly forcing them outwards and reproducing the original deformity. To guard against this deplorable result the indications are to induce the elongation of the back teeth in their sockets without altering the length of the lower front teeth; in this way the occlusion of the molars and bicuspid prevents undue impingement of the front teeth. Or it may be found when the correction-plate has been removed that the posterior molars have risen too high, and that they are the only teeth that meet. When the posterior molars have only grown a little too long, they can be depressed in their sockets by the use of a submental bandage worn continuously, or the cusps of the teeth can be reduced in height with little risk of inducing dental caries; but it is a much more difficult matter to induce the elongation of the molars and bicuspid in their sockets without altering the length of the lower front teeth, yet it is essential that the level of the back teeth shall be raised if the upper front teeth are to be drawn backwards without impingement on their antagonists. The important question then arises

as to what extent we can control the elongation of the molars and bicuspid.

We know that at any period of life a tooth that has lost its antagonist will gradually rise above the level of the contiguous teeth, though a great many exceptions to this rule could be found. Unfortunately the eruption of the teeth as a physiological process is very imperfectly understood, and in the lengthening of erupted teeth it is probable that two distinct processes are involved, dependent upon the age of the patient. After middle age the lengthening of the tooth seems to be associated with a process of extrusion, for the necks of the teeth become visible, and the teeth have evidently grown out of their sockets, after the manner of the horse's tooth; but in proportion as we approach the normal period of the eruption of the teeth we shall find that the elongation of any tooth relieved from antagonistic pressure is associated with development of the alveolar process, the free edge of which tends to preserve its usual relation at the neck of the tooth. In young adults, where a series of back teeth have been lost, it is not very uncommon to find that the antagonising teeth have risen until they have come into contact with the opposing gum, leaving no space for the insertion of an artificial denture. We are aware that the most rapid development of the alveolar process takes place at the period of tooth-eruption, for the socket of each tooth has to be developed around the erupting tooth. The elongation of the second permanent molar can be obtained almost to a certainty by relieving the tooth from antagonistic pressure at the age of twelve, which is about the period of its eruption, and is the epoch usually selected for the treatment of projecting front teeth. In less than six months the second molar will probably have grown long enough to prevent undue impingement of the front teeth when the mouth is closed, and there is reason to hope that the bicuspid, being relieved from pressure, will grow up to the normal level of antagonism with the opposing teeth.

But this happy issue is not always realised, for in the case of a young lady, now twenty years of age, whose teeth I

regulated in the year 1890, the bicuspid on one side of the mouth have failed to grow up to the desired level, although they have been perfectly free for seven years. This instance impressed me with the fact that if we especially desire to raise the level of any teeth we must free them from pressure as soon as possible after eruption. In pursuance of this view, I commenced the treatment of several cases at about the age of ten because the projecting front teeth are erupted by that time, and as the bicuspid are just appearing, the development of the alveolar process around them is in a very active stage; but I have found that the additional difficulties that beset treatment at the earlier age quite neutralize the advantages.

Where the projection of the front teeth is of only moderate degree, the defect may be remedied by drawing the front teeth backwards and raising the level of the molars and bicuspid in the manner described, but in more pronounced cases where the lower incisors meet the palate at a considerable interval behind the upper teeth, the prospects of success by ordinary methods are not very encouraging, and the most hopeful treatment depends on permanently altering the position of the mandible and at the same time training the projecting front teeth backwards. Chance revealed the possibilities of this treatment to certain old practitioners, of whom several could remember regulation cases in which a sort of spontaneous cure happened, to the surprise alike of patient and practitioner. On rare occasions it was found that after months spent in regulating projecting front teeth the mandible had assumed a more forward position, equivalent in extent to the width of a bicuspid or molar tooth, and in more than one instance the improvement was permanent. A name given was "jumped-bite."

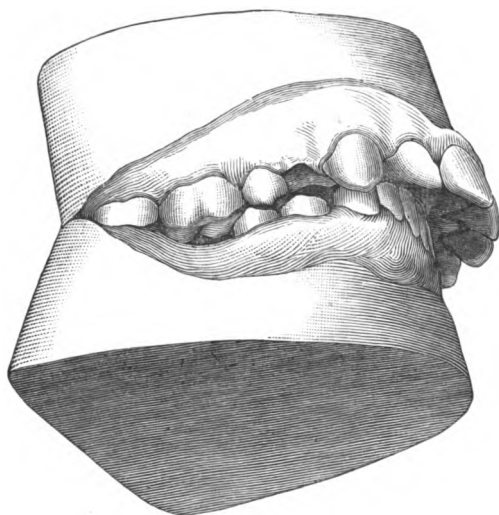
Some years ago this subject was discussed before the Odontological Society, and the anatomical mechanism of the change in position of the mandible was quite understood, and its importance appreciated. In the last three years I have been trying to utilize the anatomical fact that the whole mandible can be carried forward, and a remodelling of the glenoid cavity can be effected.

After projecting front teeth have been drawn backwards to the normal angle of obliquity, it will generally be found that the patient can protrude the mandible until the lower front teeth meet the upper arch in excellent position, but as the condyle moves forwards and downwards over the *emenentia articularis*, the back teeth become separated and the front teeth alone meet. Two main difficulties now arise, in the necessity to fix the lower jaw in its advanced position, and to secure increased vertical development of the alveolar process to restore the contact of the back teeth. Correction-plates, or retention-plates, will have to be worn for months, and by that time the erupting second permanent molars should have a remedial influence in relieving the front teeth from pressure. In gauging the prospects of success, great allowance must be made for the difficulty of treating young patients. The work should be absolutely devoid of pain, or it will promptly be abandoned, and the mechanical difficulties of constructing correction-plates that enable a child to eat comfortably and yet relieve certain teeth from contact will prove a difficult problem for the dental practitioner to solve. By the use of narrow, elastic strips of rubber-dam, which the patient can tie on to the correction-plate, the outstanding teeth can be gradually and painlessly drawn into position, but in so far as the success of the case depends on carrying forward the mandible in closing the mouth, one must rely considerably on the voluntary efforts of the patient, until the altered height and position of the back teeth has established the condyle in the new position. With this object in view, it would be a great help if one could devise a correction-plate that would enable the patient to bite in one position only of the mandible, but hitherto I have failed to effect this. Much can be done by making a series of depressions in the upper plate, into which the cusps of the lower front teeth fit when the jaw is closed in the desired position.

There are compensating advantages and drawbacks in treating older patients, for their personal vanity induces them to give the utmost aid in their power by obeying instructions.

In 1895, I selected a case for hospital treatment in the person of a young woman, *æt.* 17, whose front teeth projected beyond

the lower lip in typical style, and the lower incisors met the palate at a considerable distance behind the upper teeth. Her



other features were remarkably good. The case was under constant treatment till 1897, and the patient pays periodical visits to the conservation-room at the present time. I had to make her many correction-plates, and received every assistance from Mr. R. H. Stevens, who acted as my dresser. I easily drew the front teeth back, but found it a slow process to obtain elongation of the back teeth. The first molar had been extracted, and the second molar had tilted obliquely forwards and inwards. I made a correction-plate that pushed the second molars into vertical position and raised their height considerably. Several other teeth were missing from the arch, and eventually I raised the level of the back teeth artificially. The result was satisfactory, but the age of the patient made progress slow and treatment so tedious that I decided that I would not again undertake a case of this nature after the fourteenth year. But in 1896, whilst engaged in regulating the teeth for the daughter of a Guy's man, in whom facial paralysis made the protrusion of the front teeth very

noticeable ; the mother asked me if it were too late to do anything for her own front teeth, which stood out beyond the lower lip in a very disfiguring way. The cause of the deformity was the loss of all the back teeth in the upper jaw and the consequent impingement of the lower incisors on the necks of the upper front teeth. After due consideration, and knowing how little hope there was of any further development of the alveolar process, I made a denture, restoring the back teeth and relieving the upper incisors from pressure. This denture was used as a correction-plate, and the front teeth were drawn back by very narrow strips of rubber-dam attached to the plate. The teeth rapidly came into good position, and I began to think how they could be held in place, for even the narrowest gold band along the margin of the gum would be perceptible. The patient, however, solved the difficulty by informing me that it was her habit, when she met a friend, to displace the rubber band from the front of her teeth, whereupon it immediately retracted and disappeared from sight until the interview was over. This little manoeuvre she could execute with great rapidity by means of the upper lip alone. Under such happy conditions there seemed to be no need of any further device, and the use of the rubber band was continued.

ON THE FUNCTIONAL EFFICACY OF THE RETAINED TESTICLE.

By G. BELLINGHAM SMITH.

IN spite of the large amount of attention that has been paid from time to time to the subject of the Undescended Testicle, the question of whether at any period of its career the organ is capable of spermatogenesis cannot be regarded as definitely settled. Whilst it is maintained by some that the testicle never undergoes its full development, others hold that at puberty it reaches a stage of development so far resembling the normal condition as to be functionally efficacious so far as the production of spermatozoa is concerned, and that degenerative changes entailing sterility occur at a later period only, though comparatively early in the life-history of the organ.

I have collected together fourteen cases in which the testicle had failed to undergo its full descent, and have examined them with a view to showing:—

- (1). What deviations from the normal are present before puberty;
- (2). What developmental changes occur at puberty;
- (3). Whether spermatogenesis occurs, or appears from the structure of the organ to be a possibility;
- (4). And at what period degenerative changes make their appearance.

The fact that an individual might, even with both testicles retained, be possessed of the characteristics of the male with sexual powers practically unimpaired, and yet be incapable of furnishing a secretion containing spermatozoa was not at first recognised, and consequently but little value can be placed upon the earlier reported cases.

Hunter, who held that when a testicle failed to descend it was imperfectly formed and incapable of performing its normal functions, nevertheless considered that the only case he had seen in the human subject was an exception to the rule from the fact that the man possessed all the powers and passions of the male. He considered the failure in development as the cause of the non-descent.

The views of Hunter with regard to the inefficacy of the undescended organ were opposed by Professor Owen, who brought forward arguments derived from a consideration of the position of the testicles in various animals, to show that their retention in the abdominal cavity could not be held to impair their efficiency.

Follin, in 1851, in a paper published in the *Archives Générales de Médecine*, and later in a paper with Goubaux read before the *Société de Biologie*, placed the matter on a different footing. Up to this time, as these authors remarked, they found nothing more than "assertions without proof relative to the fecundity of individuals presenting this anomaly." Consequently, with a view to elucidating the question, they made a series of exact observations both on man and the domesticated animals.

In three cases which came under their notice of men with one testicle retained, an examination of the fluid contained in the vesicula seminalis of the corresponding side failed to reveal any spermatozoa, whilst an examination made for comparison of the opposite side showed that they were plentiful. Spermatozoa were found to be entirely absent in a man with both testicles retained. These observations in man were confirmed by numerous ones on the domesticated animals, all of which tended to show that not only were no spermatozoa produced, but that retention of both organs entailed sterility. Further

confirmation of these conclusions was afforded by a paper published a little later in the *Memoirs of the same Society* by Godard (*Mem. de la Soc. de Biol.*, 1856). In three cases reported by him of young adults, aged 24, 26 and 22, with imperfect descent of one testicle, an examination of the fluid in the vesiculæ seminales failed to show any spermatozoa on the side corresponding to the retained organ.

As further proof of the inefficacy of the undescended testicle he mentioned the cases of three cryptorchids who had had no children.

Curling, who at first had given in his adhesion to the views propounded by Owen, later on, as the result of certain observations made by him, entirely changed his opinion. In 1855 he described the case of a man, aged 36, whose right testicle was in the abdomen, small and undeveloped. "There were no spermatozoa in the efferent ducts, nor in the right vesicula seminalis, but the left contained them in abundance."

Being further desirous of settling the question, the same author, in 1864, published a paper (*Br. & For. Med. Chir. Rev.*) containing nine cases of men, either with both testicles undescended or with a single one retained, the other having been previously removed or its duct obstructed by disease, in whom, an examination of the ejaculated semen, failed to show any spermatozoa. Four of these cases had come under his own observation, and full details may be found in his work on *Diseases of the Testicle* (3rd Ed., p. 434). It is worth noting, as Mr. Jacobson points out, that the ages of these patients were respectively 38, 21, 46 and 39. Three of them were consequently middle-aged men, and the importance of the question of age in a consideration of the efficacy of the testicle will be considered later.

The evidence brought forward by these authors to show that an undescended testicle fails to furnish spermatozoa, and that imperfect descent of both testicles entails sterility, was based on these observations:—

(1). That individuals with imperfect descent of the testicles on both sides were sterile.

(2). That spermatozoa were not found in the undescended testicle or in the vesicula seminalis or excretory ducts corresponding to the anomalous organ.

(3). That spermatozoa were not found in the fluid ejaculated by several living cryptorchids.

(4). That the evidence derived from a similar condition in the domesticated animals was confirmatory.

As regards the size of retained testicles, both Follin and Goubaux on the one hand, and Godard on the other, agreed that not only is it invariably smaller than in its normal condition, but that it is sometimes soft and flaccid. But so far as the microscopical appearances go they differed entirely.

Godard, who examined eight undescended testicles maintained that, with the exception of the diminution in size and consistence, the parenchyma was absolutely identical with that of the descended gland. "The canaliculi pull out in the normal fashion, and they have a similar appearance, both to the naked eye and under the microscope."

Follin and Goubaux, on the other hand, maintained that the structure of the undescended testicle was profoundly altered. They pointed out that a thickening of the walls of the tubules took place in association with a fatty degeneration of the cells lining them; and that owing to the subsequent absorption of the lining cells, the tubules assumed the form of thin fibrous cords, whilst the interstitial tissue becoming more obvious from the contraction of the seminiferous substance gave the organ a fibrous appearance.

This description applies very closely to the appearances seen in the testicles when the secondary atrophic changes are marked. Godard's inability to find any obvious changes may have been partially due to imperfect methods of examination, but also perhaps to the fact that he examined testicles of an earlier age, that had not yet undergone any very profound change.

At this period of the discussion there were two diametrically opposite views as regards the structure of the undescended organ; the one advanced by Godard, that the testicle, though

smaller in size and incapable of furnishing spermatozoa, was practically normal, and that held by Follin and Goubaux and supported by Curling, that associated with this disability was a very definite change of a fatty and fibrous character. And in this position the argument remained until MM. Monod and Arthaud attempted to show in 1887 that there might be some truth in both statements, and whilst for a variable period after puberty the testicle and its accessory glands and ducts were capable of fulfilling their normal rôle, sooner or later sclerosis of the organ supervened, involving sterility. To this paper I shall refer later on.

The evidence hitherto given is entirely in favour of the loss of function so far as power of spermatogenesis is concerned in undescended testicles. But certain observations supporting the functional efficacy of the retained organ have been brought forward, and demand careful consideration, not only, as Mr. Jacobson points out, with regard to medico-legal cases involving paternity, but also respecting advice with regard to marriage.

This evidence is partly derived from cases in which males with testicles retained on both sides are stated to have procreated children and partly from an examination of the undescended organs, and the fluid secreted.

Three cases are quoted by Mr. Curling, all of which had come under the notice of surgeons of Guy's Hospital.

One was that of a man of 29, once a dragoon, under the care of Mr. Poland, with both testicles undescended and undeveloped scrotum. He had all the signs of virility, and had married at the age of twenty, having two children by his first wife. He had been married two years to a second wife. (Guy's Hosp. Reports, second issue, vol. I., p. 162) (Curling, p. 437, loc. cit.).

Mr. Cock had mentioned to Mr. Curling the case of a man whose testicles were undescended and in whom the virile functions were perfect. He had married twice and had had children by each wife. He was a man of dissipated habits, and had served in a public-house.

A third case was communicated by Mr. Durham. The patient was a well-grown healthy labourer of 32, with both testicles

retained and double inguinal hernia. He was operated upon by Mr. Durham for strangulated hernia, and during the operation the left testicle was exposed and seen to be smaller than usual. Since puberty he had experienced strong sexual desires; he was married and had two children.

Confirmatory evidence in the shape of an examination of the retained organs or the fluids secreted by them was not obtained, and Mr. Curling, though not without hesitation, rejected these cases and others similar to them in view of the fact that at the time he wrote spermatozoa had not been detected in any case of retained testicles in which search had been made for them. And though, as he says, he could see no valid reason why there should not be exceptions, and Mr. Durham's case he thought might be one, still the evidence was wanting that would enable one to accept the claims of paternity in the cases as indisputable.

This rejection lays him open to the reproof of accusing the wives of several men of unfaithfulness. Nevertheless, the evidence derived solely from these cases and unsupported might certainly be considered as insufficient to prove beyond all cavil the possibility of spermatogenesis in cryptorchids. Their value in this respect could only be derived from the knowledge that in certain cases, however exceptional, spermatozoa had been found either in the retained organs or in the fluid secreted. From this point of view great importance attaches itself to the case reported by Beigel (*Virch. Archiv. Bd. xvii., S. 144*; quoted by Mr. Jacobson, *Dis. of Male Organs of Generation*, p. 45.)

A patient, aged 22, had both testicles retained in the inguinal region, a condition that caused the patient no inconvenience. The left was smaller than the right, but by no means wasted. The penis was well developed, and coition was practised frequently and vigorously. A specimen of semen obtained from the patient contained a large amount of spermatozoa.

Another case is recorded by Dr. Valette (*Gaz. Hebdomadaire*, 1869, Vol. 2, p. 20). The patient, aged 21, was admitted with symptoms pointing to strangulated hernia. The testicle was

drawn up and one end engaged in the external abdominal ring, but it could be disengaged and the canal explored. It is worthy of note that this testicle did not appear to be enlarged nor was it painful. The testicle was said to frequently occupy the inguinal canal, but ordinarily it descended into the scrotum, without, however, reaching the same level as that on the opposite side. On account of a recurrence of these attacks the testicle was removed. Nothing abnormal was evident to the naked eye, either as regards the size or texture of the organ. A drop of secretion from the end of the vas deferens showed spermatozoa, few in number and immobile. There was no alteration visible in the parenchyma, with the exception that the central cells were a little more fatty than normal. There was found in it only a small number of immobile spermatozoa.

This case is not entirely satisfactory as an example of retained testicle. Though sometimes drawn up into the inguinal region, it usually occupied a position in the scrotum, although not at the same time level as that on the other side. The affection from which the patient was suffering is not made clear, but it seems to me not unreasonable to regard the condition as one of retraction of the testicle, associated perhaps with neuralgia. The organ, moreover, is noted to have been of a normal size. I have considerable doubts, therefore, as to whether one would be justified in accepting this as a case of spermatogenesis in an imperfectly descended organ.

A case in which the testicles of a cryptorchid, who had a son eight years of age, were submitted to microscopical examination, is published in some detail in the *Gazette Hebdomadaire*, for 1861, by Dr. Debrou (*Gaz. Hebd.*, 1861, Vol. 8, p. 3).

J. L., æt. 42, died of a strangulated inguinal hernia of the right side. Both testicles were undescended. The right, which was retained in the inguinal canal, was flattened, pale-grey, soft and flaccid, 4 cm. long by 3 cm. broad and .6 cm. thick. On the left side the testicle was situated in front of the external ring, was 3 cm. long by 2 cm. broad and .5 cm. thick. The patient was of ordinary size, with the male characteristics all well marked. He had a son who was eight years old at the time

of his death, very delicate, and of a size below his age. The testicles of the boy were descended but were so small as scarcely to be felt. The testicles of the patient, examined microscopically by M. Gosseling and M. Godard separately, showed no spermatozoa. Apart from a little discolouration the tissue was normal.

Though we have in this case another example of paternity in a cryptorchid, the evidence necessary to render this conclusive, the discovery, namely, of spermatozoa in the fluids secreted or in the testicles themselves is wanting. We can by no means conclude, however, that they were absent at an earlier period. On the other hand, all the information we have at present points to the fact that whatever likelihood there may be of spermatogenesis in a young man with his testicles retained, by the time he reaches forty degenerative changes will almost certainly have set in, with associated loss of function so far as procreation is concerned.

So far the evidence in favour of functional efficacy in undescended testicles was based mainly on cases of alleged paternity, the only confirmatory evidence, but that of considerable value being the discovery by Beigel of spermatozoa in the secretion of a cryptorchid.

In 1887,¹ in a contribution to the study of the Ectopic Testicle, MM. Monod and Arthaud described more accurately than had previously been done the anatomical alterations to which the absence of spermatozoa might be ascribed, and at the same time described what they thought to be the course followed by these changes. They based their remarks upon three cases which came under their observation, one of which was of very great importance in regard to the question of the possibility of spermatogenesis in cryptorchids.

In this case a testicle, removed from a young man of twenty, presented to the naked eye its normal size and aspect; the tubes pulled out easily, more easily perhaps than normal. There was slight thickening of some of the walls of the seminiferous tubules, a slight increase in the connective tissue separating

¹ Arch. Gén. de Méd., 1887, Vol. 2, p. 641.

them, and a thickening by endo-periarteritis of the vessels. The protoplasm of the cells lining the tubules was granular and enclosed fatty-deposits, whilst the outlines of the nuclei and cells were indistinct. Nevertheless, in spite of these modifications of structure it was evident that spermatogenesis was not suspended. Spermatozoa were found free in the interior of half at least of the tubes, and karyokinesis could be followed in its different phases.

“An examination of this first testicle,” say the authors, “shows us that ectopia of the organ need only entail slight modification of structure and may allow of the preservation of its function.”

In this case the displacement had never been troublesome and had been accompanied by no alteration in health. Operative intervention had been undertaken for a concomitant strangulated hernia.

The illustrations that the authors supply of this case shews very marked changes indeed, not the slight ones that they say may easily be overlooked. The walls of the tubules are shown to be very much thickened and the interstitial connective tissue in great excess; and Dr. Griffiths, commenting on the case, says “All I need say with regard to the view maintained by Godard, Monod and Arthaud, that the retained testicle does acquire its full size and powers of producing spermatozoa at and soon after puberty, is that I have not found any evidence in its support. There has never been brought forward an indisputable case of the detection of spermatozoa in retained testicles; and what Monod and Arthaud have depicted as a section of the testicle in which the seminal tubules are said to be in the act of producing spermatozoa is indeed without the text unrecognisable as a section of that organ at all.”

When we consider the experience of these authors in all that appertains to the testicle and its diseases, I think we can have no reason to doubt the accuracy of their observations with regard to the presence of spermatozoa in the organ examined by them. The illustration, no doubt, is an unfortunate one, but the description, which is full and detailed, must be regarded as

representing the truth of the matter. My own observations, as I shall show later, tend to show the possibility of spermatogenesis in a retained testicle.

The testicles removed from the other two patients, both men over forty, showed extensive degenerative changes, "thickening of the albuginea, and of the walls of the seminiferous tubules, endo-periarteritis of the vessel walls, perivascular sclerosis, fibrous induration of the body of Highmore, and finally the progressive disappearance of the epithelium, which was practically absent in half the canaliculi." There was no karyokinesis or spermatogenesis. Upon the evidence derived from these cases, the authors deduce a "general theory of the evolution of the ectopic testicle." They distinguish three stages in the course of an undescended testicle:—

(1). In the first period, the testicle is capable of fulfilling its normal function of spermatogenesis.

(2). In a second period the testicle still preserves its functions, but a peri-vascular sclerosis and induration of the body of Highmore interferes with the excretion of the products of secretion, hence we get sterility without atrophy.

(3). Finally there supervenes atrophy of the gland, characterised by proliferation of the connective tissue, and a progressive disappearance of the epithelial elements.

They attempt in this way to reconcile the different views of Godard and Follin with regard to the structure. "One may conclude from these facts, and from those observed by Follin, that the undescended testicle primarily healthy, as Godard had noted, or presenting no other change than a slight diminution in size, undergoes little by little, in consequence of the advance of age, perhaps also as the results of injuries to which the inguinal retention is exposed, a slow, gradual and uniform atrophy." (Monod and Terrillon, *Maladies du Testicule* 1879, p. 46.)

Mr. Jacobson accepts the above view of the case. "The above fact, that a misplaced testicle is healthy and functional at first, and only becomes degenerate and sterile after a time, according to the pressure and irritation to which it has been subjected, accounts for much of the dispute which has taken

place as to the sterility of patients thus affected." He also draws attention to the question of age, and lays stress on the fact that in the instances in which cryptorchids have been stated to be the fathers of children, they have married early.

Dr. Griffiths,² in a series of valuable experiments, was unable to substantiate the views of Monod and Arthaud, so far as retention of the testicle in the dog was concerned, and he states that the few cases he has examined in man bear out his observations. His experiments consisted in replacing within the abdomen the testicles of young animals in which the organs were immature and undeveloped, and those of full grown animals in which the testes were of the full size and mature structure.

He found as the result of the first set of experiments that "the testicle of a young animal, when replaced in the abdominal cavity, does neither acquire its full size or its mature structure, nor does it acquire the power of producing spermatozoa. Though it does to some extent partake of the general growth of the body, it does not do so to the same extent as the organ which occupies its natural position." At puberty the testicles "lose what may be called their infantile character, and acquire a structure that is peculiar to the replaced and also the undescended organ; that is to say, the seminal tubules during early life are solid rods of small polygonal cells, whereas those of the retained testicle at and after puberty are lined by a layer of delicate columnar cells which project as fine processes into and fill the lumen, the central cells of the tubules having disappeared. The testicle remains in this state: at least we have no evidence that it undergoes further change."

"The testicle of a full-grown dog, when replaced in the abdominal cavity, soon dwindles to two-thirds or one-half its natural size, and after a short time presents precisely the same structure as that which is found in the replaced testicle of a young animal above noted."

"The testicle, the descent of which has been arrested in the dog, either in the groin or the abdominal cavity, shows the same

² Journ. of Anat. and Phys., 1893, Vol. 27, p. 483.

histological characteristics as the organ which has been replaced by experiment."

In a subsequent paper (*Journ. Anat. and Phys.*, vol. 28, 1894, p. 209, Dr. Griffiths gives the results of the microscopical examination of four cases of undescended testicle in man—one a cryptorchid, the other three monorchids. None of these showed spermatogenesis, or any evidence of activity in the cells lining the tubules. Two of these, it should be noted, were aged 34 and 40 respectively; the age of one is not noted, but from the account given was, apparently, not from a very young man; whilst the fourth was aged 19.

He draws attention to the fact that the epithelial cells lining the tubules acquire a columnar shape as in the dog when the testicle is replaced in the abdomen, and he concludes, from their structure, that retained testicles, though capable of giving the necessary stimulus to the production of the male characteristics, are, nevertheless, incapable of producing spermatozoa.

We have, then, at the present time, two conflicting views with regard to the structure and functions of the undescended testicle.

The one held by MM. Monod and Arthaud, that the testicle undergoes, at puberty, developmental changes, either similar to, or at all events not far removed from the normal, and is for a time capable of spermatogenesis; and that this is followed by the early supervention of atrophic changes; and the view held by Dr. Griffiths that at puberty there invariably occur developmental changes differing from the normal, and that spermatogenesis is not possible at any period.

During the last year or two I have examined from time to time testicles which have failed to descend in the human subject, and have been removed for various reasons. I have now collected them and examined them carefully with a view to showing how far they support one view or the other—whether at puberty and after the testicle passes through any stages of development resembling the normal condition and is functionally active so far as spermatogenesis is concerned, or whether on the other hand, as Dr. Griffiths maintains, the testicle at puberty, whilst increasing in size, nevertheless fails to develop normally, but

undergoes certain changes which may be regarded as characteristic of the undescended gland. That is to say, whether in a case of sterility from non-descent of the testicles, we are to regard this failure in sperm-producing powers as due to a defective or abnormal development, or to the early supervention of degenerative changes in a testicle that has at puberty undergone its normal development, or changes not far removed from the normal. And I may say at once that to a varying extent in different cases both conditions exist, primary want of development being the most marked feature in some, whilst in others the organ has undergone a series of changes not very remote from what usually takes place at puberty, followed by early degenerative changes.

There are nine cases over the age of puberty (sixteen years to thirty-seven years of age), and these I have arranged in order according to the want of development shown.

A. Very marked want of development antecedent to puberty.

CASE I.—F. F., æt. 16, was admitted under the care of Mr. Howse on December 2nd, 1896. Patient has never had the testicle in the scrotum on the right side. About eighteen months ago he noticed a swelling in the right groin, which was particularly evident when walking and which gave him pain.

On admission, no testicle was found in the scrotum on the right side, but a small body could be felt about the level of the internal ring. When patient has been standing up for some time this may be felt by passing finger up the inguinal canal; it is small and undeveloped. It was removed on December 11th.

The body of testis on removal measured 2 cm. long, $1\frac{1}{2}$ cm. from before backwards, and 1 cm. wide. The tubules are very sparsely scattered through section, and are separated by large areas of mucoid-looking areolar tissue with but few nuclei. The tubules vary in size, some of them are still in the stage that is characteristic before puberty, or but little advanced beyond this, the cells forming solid columns. Others, rather larger in size, are possessed of a small lumen and are lined with several layers of irregular polyhedral cells, with small oval deeply staining nuclei, as in the pre-puberty stage, or with a layer of

long columnar cells, with ragged ends tapering towards centre of tubule. What is specially noticeable in the section is the large number of interstitial cells, which occupy an area larger than that occupied by the tubules themselves. There is a little thickening of the tunica propria of the tubules.

This testicle shows a very marked failure in development, not only as regards the changes that should occur at puberty, but dating back to a period antecedent to this, as is shown by the extreme paucity of tubules. It may be regarded as the most ill-developed organ in the series.

B. Defective development at and after puberty; tubules lined with columnar cells.

CASE 2.—A. G. D., æt. 21, admitted under the care of Mr. Howse, October 10th, 1897. Whilst carrying some heavy books four weeks ago he struck himself in right inguinal region with one of them, and immediately experienced great pain in that part. Thinking he had ruptured himself, he consulted his medical man, who told him the pain was due to non-descent of the testicle. He had never noted the fact till then.

On admission, there is a swelling about the position of the internal ring that on pressure gives testicular sensation. This is somewhat painful when the hip-joint is extended, and the skin stretched tightly over it. Left testicle is in its normal position.

The right testicle was removed from the groin on October 4th. The testicle removed was plump and well-shaped. The body of the testis was $2\frac{1}{2}$ by 2 by $1\frac{1}{2}$ cm.

The appearance presented by this testicle under the microscope approaches more nearly than any other in the present series to the appearances described by Dr. Griffiths as invariably occurring in dogs as the result of non-descent or replacement of the testicle in the abdomen. The tubules are about one-half to two-thirds the normal size, with some thickening of the tunica propria. They are fairly closely packed, with a comparatively small amount of interstitial tissue, which is a little firmer looking than normal. The tubules are lined with from one to three or four layers of elongated cells, which taper off towards the

central lumen. The extremities of the cells present a ragged appearance, and sometimes coalesce in a central irregular network, which has the appearance of being the remains of degenerated central cells. The cells present a longitudinal striation, and possess small oval deeply-staining nuclei, none of which show any signs of activity.

It differs entirely in appearance from the organ, both before and after puberty. A certain amount of development has taken place at puberty, as evidenced by increase in growth of the organ, and the larger size of the tubules with the formation of a small lumen. The characteristic lining cells of the normal tubule have, however, not been formed, but instead longitudinally fibrillated and elongated cells, which are similar to those described by Dr. Griffiths as occurring in the testicle that has been replaced in the abdomen of the puppy or adult dog. It is noteworthy that this testicle was of fair size and plump, and had never given the patient any inconvenience till the occasion upon which he had struck himself.

C. In this group, which includes three cases, the development of the testicle has advanced a stage further than the preceding, the cells lining the tubules approaching more nearly the normal condition.

CASE 3.—G. W., æt. 21, admitted under the care of Mr. Howse, February 17th, 1897, for retained testicle on the left side. When playing football he developed a strangulated hernia on the left side, and was previously operated upon for this. A protrusion from the external ring still occurs when he coughs. He has never had the left testicle in his scrotum. The left testicle may be felt as patient lies in bed opposite the internal abdominal ring. When he coughs it may be caught and pushed down to the external ring. Radical cure of hernia was performed and the testicle removed. The testicle is of small size, the body of the testis being 2 by 1·5 by 1·5 cm. There may be seen in the sections with the naked eye several small islets, more deeply stained than the surrounding parts, about the size of a pin's head. Microscopically these small areas are composed of undeveloped tubules in the pre-puberty stage. In addition

to this there are a few scattered tubules lined with a single layer of long, regular, thin, columnar cells, with small, oval, deeply-staining nuclei of the same size and appearance as the pre-puberty nucleus, and possessing a small lumen.

The majority of the tubules are larger (one-half to two-thirds the normal size), and lined with one or two layers of well-formed polyhedral cells, with rather larger, deeply-staining nuclei. These nuclei are smaller than in a well-developed testicle, stain evenly and deeply, and show no nucleoli nor evidence of activity. In some of the tubules the long, tapering, ill-formed cells described in the preceding cases are to be seen.

The tunica propria of the more developed tubules is considerably thickened, showing, in many instances, the inner, finely-fibrillated layer with but few nuclei or devoid of them, and an outer layer composed of two or three layers of flattened connective tissue cells.

The intertubular tissue is comparatively large in amount, and is composed of a richly-nucleated, wavy, areolar tissue, containing a large number of characteristic "interstitial cells." The vessel walls are considerably thickened by an endo-periarteritis. The tunica albuginea is thick.

This testicle is to be regarded as an ill-developed organ, though more advanced than the preceding, but without any evidence of spermatogenesis.

Secondary degenerative changes are obvious in the thickening of the tubules and vessels.

CASE 4.—Patient aged 28. The testicle was given to me by Mr. Jacobson, who removed it from a private patient. The testicle was plump and of a fair size, the body of the testis measuring 2.5 by 2 by 1.5 cm.

The appearances presented are very much the same as in the preceding. There are, however, fewer undeveloped tubules (tubules in the pre-puberty stage), and the nuclei of the cells lining the tubules are larger, clearer, and contain a well formed nucleolus. The tubules are rather larger, and lined with two or three layers of irregular polyhedral cells, or in some cases with a single layer of ragged columnar cells. The nuclei are all in the

resting stage, showing no mitotic figures. It shows the same secondary degenerative changes as the preceding. The thickening of the walls of the tubules is, however, less advanced.

CASE 5.—Testicle from a man of twenty. Resembles the preceding very closely, and the same description may be held to apply, both as regards the primary want of development and the secondary degenerative changes.

The testicle is, however, rather smaller in size, the body of the testis measuring 2 by 1.75 by 1.25 c.m.

D. *In this group the cells lining the tubules show signs of activity, as evidenced by the presence of karyokinetic figures.*

CASE 6.—W. H., æt. 21., admitted under the care of Mr. Golding-Bird, January 12th, 1898. Till five years ago patient says both testicles were descended and were at the same level, about the middle of the scrotum. He noticed at this time that the left one had disappeared, and that it was situated in the abdomen. He has had attacks of sharp aching pain in the right testicle, lasting for two or three hours at a time, during the last year, at intervals of a month to six weeks. No pain at all in the right side. Patient has all the male characteristics well marked.

On admission, the right testicle is situated an inch below the external abdominal ring, the position it has always occupied according to the patient; it is about the size of a broad bean.

The left testicle is situated about the position of the internal ring, and can be felt on fairly deep palpation. It is tender to the touch, but not painful, except during the attacks mentioned.

An operation was performed on January 18th. On making an incision in the left inguinal region, it was found that the external ring was closed, and there seemed to be no doubt that the left testicle had never descended. The testicle was found on the internal aspect of the abdominal wall, enclosed in a peritoneal covering, and kept fixed in that position by a thick band of tissue, which ran from the lower end of the testicle into the scrotum. The organ was of good size, but owing to its attachments it was found impossible to bring it down into the scrotum. It was consequently removed. The testicle was found to be a fairly

well developed organ, larger in size than the more fully descended organ on the right side. The tubules could be readily pulled out.

On microscopical examination this testicle presents very much more closely the appearance of a normal organ as regards the character of the cells lining the tubules than is the case in those that have previously been considered. But at the same time, marked degenerative changes have already made their appearance. The tubules all show more or less thickening of the tunica propria, and here and there this has gone on to almost complete obliteration of the lumen, and destruction of the enclosed cells. But a large number of the tubules are of fair size, and are lined with from two to four layers of cells, which in size and appearance recall those of the normal testicle. Their nuclei are of large size, round or slightly oval, and a considerable number of them show mitosis. Here, however, the process ceases, and the further stages in the formation of spermatozoa are wanting.

The long, tapering, fibrillated cells seen in the preceding cases do not occur in this testicle. The tubules are fairly closely packed and the interstitial tissue is in but slight excess. The vessel walls are much thickened.

This testicle is an important one, in that it shows a development not far removed from the normal. The marked activity of the nuclei might lead one to suppose that the further changes in the production of spermatozoa were not impossible.

It is important to note the marked degenerative changes that have already supervened in an organ so well developed, leading to the destruction of many of the tubules, and showing that the period of possible activity of this testicle would be of very short duration.

Another point of interest is that this testicle is larger and apparently better developed than the other which has undergone a further stage in its descent to the bottom of the scrotum. This may be, as has been suggested, owing to its greater protection from injury within the abdominal cavity than in the groin; but the other cases of the series do not lend much support to this view.

This is the only cryptorchid in the series, and it seems possible that when both organs have failed to descend, and have not undergone their full development, the incentive to the production of spermatozoa in one or both of them may be greater than is the case in an undescended organ when its fellow has undergone its full descent.

CASE 7.—W. R., æt. 20, admitted under Mr. Davies-Colley, April 5th, 1897. Patient has his testicle retained just outside the external abdominal ring, and he says that it never descended to the bottom of the scrotum. It never caused him any inconvenience, and he was able to enter the army. Eleven months ago he was kicked in the hypogastric region by a horse, and was unconscious for eight hours. After this the testicle was rather higher than before, and was painful. He was discharged from the army two months later, as he was unable to ride. He is now a labourer, and complains that work causes him pain.

The left testicle is abnormally small; there is compensatory hypertrophy of the right one. Associated with the undescended organ is a hernia. An operation for radical cure of hernia was performed, and the testicle removed.

The body of the testis was 2·5 by 2 by 1·5 cm. This testicle also shows activity in its nuclei, though to a less extent than in the preceding specimen. Here and there may be seen small clumps of tubules in the solid undeveloped condition. It shows, however, less advanced degenerative changes than the preceding, though on the whole it is a less well developed organ. These two changes seem to bear an inverse ratio one to the other. The higher the development of the organ the earlier and more marked are the retrograde changes.

E. Cases showing advanced degenerative change.

CASE 8.—B. D., æt. 37, admitted February 9th, 1898, under Mr. Howse for strangulated hernia on the right side. This was reduced and patient was discharged. He was re-admitted on February 15th for inguinal hernia and undescended testicle on the right side, and an operation was performed. There was an unobliterated processus vaginalis. Radical cure of hernia was performed and the testicle was removed.

CASE 9.—A. M. æt. 29, admitted December 24th, 1896, under the care of Mr. Davies-Colley. Patient has had a swelling in the right groin since birth, which has increased in size in proportion to his growth. This swelling descends into scrotum and can be readily reduced as a rule; it has, however, on two occasions been replaced under an anæsthetic. The left testicle is in its normal position in the scrotum. When patient awoke this morning he found he was unable to reduce the swelling.

On admission, patient had a hernia in the right side of scrotum which was reduced after the application of an icebag. On January 2nd an operation was performed for the radical cure of hernia. The right testicle was found in the inguinal canal, where it was bound down by a short mesorchium. The testicle was removed, and measured two and a quarter inches long and one and three-quarter inches broad.

Marked degenerative changes are present in both these testicles, and there is extremely little to choose between them. That from the older patient shows perhaps rather more interstitial fibrous tissue. The same description practically applies to both.

The walls of the tubules are much thickened, showing an outer thickened layer of flattened connective tissue cells and an inner finely fibrillated layer of considerable thickness. The tubules are very much diminished in size, and the lumen is encroached upon by the thickening of the tunica propria, in many cases being practically obliterated. They are lined by a single layer of degenerated granular cells, and in the more extreme cases contain only a little granular detritus.

The tunica albuginea is thick, and the tubules are separated by a considerable amount of loose wavy connective tissue. The vessel walls are much thickened. There are a considerable number of the characteristic interstitial cells, which are especially abundant in the younger patient (Case 9).

It is impossible to say what stage of development these tubules reached, and whether they were ever functionally capable of spermatogenesis. They have undergone, however, at a comparatively early age, a very marked degeneration, that resembles in most particulars the change met with in senile testicles.

Though I find no definite statement to this effect, I believe that the view generally held is that before puberty, though the undescended testicle may be somewhat smaller than one that has assumed its normal position in the scrotum, the microscopical structure is not appreciably altered. The appearance presented by the testicle in Case No. 1 led me to doubt this. The extremely small number of tubules pointed to an early want of development.

To satisfy myself on this point, I examined sections of several testicles that had failed to descend and had been removed before the age of puberty, and compared them carefully with sections of testicles that had undergone the full descent in boys of about corresponding ages. The result of this comparison was as follows:—

(1). The testicles were always smaller than the normally descended organ of the same age, varying from one-half to three-quarters of the normal size. This was the case even in a boy aged 3, in whom the testicle was not much more than half the size of several examined at about that age that had reached the scrotum. This shows that the arrest in development starts at an early period.

(2). Microscopical sections show, in addition, a departure from the normal structure. The tubules are sometimes rather smaller, but the most obvious change is an increase in the amount of intertubular connective tissue. This increase occurs, not only between the lobules, but also between the individual tubules, and is associated with a diminution in the number of tubules.

This sparsity of tubules was most marked in Case 1, described above. They were also very deficient in the following case:—W. C., æt. 15, admitted October 3rd, 1894, under the care of Mr. Davies-Colley, on account of pain in the left groin when walking. The right testicle has assumed its normal position in the scrotum and is of fair size, being approximately one and a half inches long. There is a swelling in the region of the left inguinal canal, rather less than an inch in its long diameter, and very painful to touch. He has had this swelling as long as he can remember; it has only been painful for a year. On October

9th, the left testicle was removed from the inguinal canal. It was rather less than an inch long, soft and flabby.

The body of the testis was small, measuring 1·5 by 1 by 1 cm. On microscopical examination it was seen that the tubules in the periphery were closely packed, and were undergoing the changes that occur at puberty. The tubules were larger in size than those in the pre-puberty testicle; some were still solid, others showed the formation of a small lumen. They were lined with several layers of clear polyhedral cells with small oval deeply-staining nuclei. In the central part of the testis, an area corresponding to about half or rather more of the surface of the section, is occupied by lobules composed of a few tubules but slightly convoluted. These tubules are solid, of small size, having a diameter that is not much more than half the size of the tubules of a normally descended testicle of a boy of twelve, widely separated from one another in the lobules, and the lobules again widely separated by large areas of very sparsely nucleated fibrous tissue.

The cases examined were six in number, and varied in age from three to fifteen.

The *conclusions* that may be drawn from the preceding cases, as regards the structure of the undescended testicle, are as follows:—

(1). The undescended testicle before puberty is not only smaller than normal, but shows definite evidence in diminution in number and size of tubules of developmental defects.

(2). At puberty there is an increase in the size of the organ, and corresponding to this certain developmental changes occur, which apparently vary in different cases to a considerable extent.

A. In some cases, as exemplified in Case 2, the tubules assume a form similar to that described by Dr. Griffiths as occurring invariably in animals when the testicles are undescended, or are replaced in the abdomen. They become lined with long delicate columnar cells, quite unlike anything seen in the normal organ. Whether this form undergoes any further development I am unable to say. Dr. Griffiths thought it remained as the permanent

structure of the organ. In case No. 2 it showed no signs of further development, though the patient was aged twenty-one, and the testicle was plump, well shaped, and of fair size. Nor can it be considered as a degenerative change, as the other evidences of degeneration were comparatively little marked. As a change involving the whole organ it is apparently rare, but affecting a few tubules it is seen in some of the other undescended testicles.

B. A more common condition is that described in the cases in group C, in which the appearances more closely approach the normal, the tubules being mostly lined with two or three layers of polyhedral cells, though, in many instances, the nuclei are still small, oval, deeply-staining, and resembling the pre-puberty nucleus. The nuclei, moreover, nowhere showed any evidence of activity.

C. A more advanced stage, and one not very far removed in general appearance from the normal, is shown in the Cases 6 and 7. In both there is considerable activity, as evidenced by the large number of nuclei presenting mitotic figures. Here, unfortunately, the process of spermatogenesis ceases. I have found nowhere any spermatozoa, and the only specimen that I know of to fill the gap is the one described by MM. Monod and Arthaud.

My specimens do, however, show this, that the development of the testicle may reach an advanced stage, and it does not appear to me highly improbable that in some rare instances spermatogenesis may occur. It is possible that these two testicles may, at a preceding date, have been functionally active, but, as the ages at the time of removal were but 21 and 20, if we assume that the period of utility, so far as spermatogenesis is concerned, is passed, the practical use of an organ which has reached its climacteric at such an early period as 21 may be practically disregarded. That the activity of the organ has an early age limit is supported, as Mr. Jacobson has pointed out, by clinical evidence. Most of the cryptorchids for whom paternity was alleged married about the age of twenty.

(3). Finally, degenerative changes occur, as have been noted by Follin, Monod and Arthaud. These consist mainly in a thickening of the walls of the tubules with gradual diminution in their size, and degeneration and disappearance of the cells lining them, a thickening of the walls of the arteries and a relative increase in the intertubular connective tissue. This secondary degenerative change makes an appearance at an early stage and is already well marked at about the age of twenty in some of the specimens. It has reached an extreme point in a patient aged twenty-nine (Case 9). A photograph of a section of an undescended testicle in an advanced stage of atrophy is shown by Mr. Lockwood in the *Path. Soc. Trans.*, 1897, p. 136, and gives well a general idea of the appearances presented by these cases.

With regard to the epithelial-looking cells in the intertubular tissue, I may here draw attention to the fact that Mr. Shattock has already pointed out their excess in a case of undescended testicle shown by him at the Pathological Society³, and has suggested that they may have some connection with an internal secretion. We know that the testicle has a two-fold function, that of spermatogenesis and that connected with the development of the male characteristics. These interstitial cells may possibly bear some relationship to the latter function. They are well marked, and appear to be excessive in number in all the specimens, and, as I have pointed out, they form a very marked feature in the sections of the testis from Case 1.

Reverting once more to the conflicting views held, on the one hand by MM. Monod and Arthaud, and on the other by Dr. Griffiths, it is obvious that neither represents the invariable course of events. Though the changes described by Dr. Griffiths are present throughout in one case, and though some of the other sections show, here and there, tubules lined with the characteristic cells, such a structure cannot be held to be the usual feature of the undescended organ.

Nor, on the other hand, are Monod and Arthaud correct in claiming for the undescended testicle a cycle of changes, which,

³ *Brit. Med. Journ.*, February 20th, 1897.

though limited to a few years, are comparable to those that the testicle undergoes in its normal evolution from puberty to old age. At all events, we have no proof that such a course of events is an invariable or even the common one. That, however, an undescended testicle may undergo more advanced development than Dr. Griffiths would allow is shown by some of the cases I have described, and though I have not been able to demonstrate the presence of spermatozoa in my own sections, I think it very likely, from the appearances they present, apart from such confirmatory evidence as is afforded by the testicle examined by MM. Monod and Arthaud, that the process of spermatogenesis is an occasional one. In all the cases, with one exception, one testicle only had failed to descend, the other having assumed its normal position, and being, so far as one knows, functionally active. It is worth considering whether the incentive to spermatogenesis is not greater in those in whom both organs have failed to descend, and whether, under such circumstances, the proportion of cases might not be greater in which spermatozoa could be detected in the undescended organ. Some slight support is given to this suggestion from the fact that the most fully developed and the most active organ examined was from a cryptorchid (Case 6).

We have to consider from the practical point of view :—

(1). The advisability of removing such an organ, the other being descended. So far we have no evidence that any harm results to the individual from such a proceeding. The one testicle is sufficient for all purposes of fertility, and probably is alone able to carry out the other little understood functions.

(2). The question of fecundity in a cryptorchid. The evidence derived from my specimens stops short at the demonstration of actual spermatogenesis; but the fact that mitosis is very marked in two cases, the evidence of Monod and Arthaud with regard to spermatogenesis in one case, the detection of spermatozoa in the ejaculation of a patient by Beigel, with such support as is afforded by reported cases of paternity, are sufficient to show that one is not justified in denying paternity in any case in which a man, married young, is the subject of dispute.

When, however, we come to the question of advising marriage the case is somewhat different. There is no doubt that the mass of evidence is against the fertility of such subjects, and the cases to oppose this in which evidence of spermatogenesis is obtained are very few. Moreover, degeneration sets in so early, being marked at the age of twenty, that the testicles of a cryptorchid have probably a very short period of activity. Consequently I think but few hopes should be held out of the possibility of children to such a marriage, especially if the patient is nearer thirty than twenty, and in spite of the fact that he may be virile and possessed of sexual feelings.

SUMMARY.

(1). The undescended testicle before puberty is not only smaller than normal, but shows definite evidence in diminution in number and size of tubules of developmental defects.

(2). At puberty, whilst increasing in size, it usually shows evidence of defective development in the character of the lining cells of the tubules, these sometimes differing entirely from the normal, as described by Dr. Griffiths, or more often approaching the normal appearance, but showing no signs of activity.

(3). Occasionally the organ reaches a stage of development scarcely distinguishable from the normal, the cells showing marked activity, and in one case (Monod and Arthaud) the formation of spermatozoa.

(4). The occurrence of mitosis, the discovery of spermatogenesis in the testis, and of spermatozoa in the secretion (Beigel), with such evidence as is afforded by the many reported cases of paternity in cryptorchids lead us to the conclusion that the undescended testicle may on occasions, perhaps rare, be efficacious so far as spermatogenesis is concerned.

(5). The efficacy, however, of such an organ is soon lost by the supervention of degenerative changes allied to the senile change.

(6). One is consequently not justified in denying paternity in a cryptorchid, at all events of an age not far removed from twenty; nor, on the other hand, should one hold out many hopes of successful issue to a man so affected.

THE ACTION OF NORMAL SERUM UPON THE ANIMAL ECONOMY

WITH ESPECIAL REFERENCE TO THE POSSIBILITY
OF ITS EMPLOYMENT SUBCUTANEOUSLY
AS A FOOD-STUFF.

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(COMMUNICATED BY THE EDITORS.)

THE administration of large doses of antitoxic and antimicrobial sera for various diseases of bacterial origin suggests the question as to what part of the resultant effects is due to the blood-serum—or vehicle per se—apart from the specific Antikörper which are therein contained. Happily, recent advances have obviated the necessity of using the heroic quantities which were required as a remedial dose when the sero-therapeutic method was first introduced, and when only antitoxins of feeble potency were obtainable. The earliest cases of diphtheria treated by Behring received as much as 90 c.c. of serum derived from an immunized sheep,¹ whilst to others 40 c.c., or more, of dog-serum² were given. Roux, Martin, and Chaillou³ mention cases where 205 c.c. of horse-serum were employed on children, and Vaillard⁴ gives instances of the treatment of tetanic patients with amounts

¹ Deutsche Med. Woch., 27th April, 1893, No. 17, p. 389.

² Wernicke, —Archiv für Hygiene, Band XVIII, 1893, p. 249.

³ Annales de l'Inst. Pasteur, 1894, T. VIII, p. 645.

⁴ Ibid. 1893, T. VII, p. 107.

ranging from 400 c.c. downwards. In the London Fever Hospitals,⁵ during 1895, 80 c.c. of antidiphtherin were often administered to patients within twenty-four hours, and in John ward, Guy's Hospital, in November, 1894, a child of five received 320 c.c. within two days. As far as can be ascertained, no ill effects, direct or indirect, immediate or remote, beyond the occurrence of the well-known rashes and transient pyrexia could be attributed to the action of the serum itself, although given in such enormous bulk.

It seems hardly likely, however, that blood-serum—a body, to use a phrase of M. Variot, “aussi complexe que l’opium”—would behave like a neutral or physiologically inert substance when introduced into the animal organism. Behring⁶ originally asserted that the sheep's serum which he employed for the treatment of his earliest cases was “as harmless as sterilized normal saline solution.” Such a statement is, of course, merely the picturesque language of a discoverer who is loath to admit the existence of any blemish in his invention; but, although this view is no longer tenable, it can now be definitely laid down as the result of six years' experience that the toxic sequelæ of injections are both few in number and insignificant in nature. It is necessary to enquire, however, what influence the serum from a healthy untreated animal is capable of exerting upon the body-metabolism. Considering the striking results obtained by Claude Bernard by the introduction of egg albumen into the blood-stream of dogs and rabbits, we should *a priori* imagine that the injection of large quantities of foreign albuminoid material into the tissues would almost certainly excite very definite metabolic changes. In the work detailed in the following pages an endeavour has been made to trace the ultimate fate of incorporated serum-albumen, and to ascertain whether the latter plays any rôle in nutrition and assimilation, and finally whether by means of normal serum it is possible to carry out subcutaneous feeding in man.

⁵ Rep. of Med. Superintendents of Met. Asylums Board on use of Antitoxic Serum, 1895, p. 27.

⁶ Loc. cit. p. 389. “Das von mir hergestellte Diphtherieheilserum, welches von diphtherie immunisirten Schafen stammt, ist für den Menschen eine ebenso unschädliche Flüssigkeit, wie eine sterilisirte physiologische Kochsalzlösung.

The last problem will be dealt with first, because it is the least complicated. By a careful investigation upon the lower animals, it can be easily and conclusively settled whether liquid serum, injected into the cellular tissues, possesses any direct nutritive value. With this object a series of experiments has been carried out on rats, mice, guinea-pigs, and rabbits, with sera obtained from the horse, ass, sheep, bullock, and dog. The plan adopted was to starve the subjects absolutely, submitting them, however, to a regular daily course of hypodermic injections of serum. As control observations, other animals of the same size and species were also starved, and their weights and conditions compared with the treated animal. To avoid repetition, it may here be said that omnivora, such as the rat, tolerate the injections much better than purely vegetable feeders such as the guinea-pig and the rabbit, and are consequently better adapted for the present purpose. Further, for reasons which will be subsequently dealt with, the only sera suitable for continuous injection are those obtained from the horse and the sheep, but especially from the former. In future, therefore, by the term "serum," horse-serum will always be implied.

As a summary of a lengthy series of experiments the following conclusions were arrived at:—

(1). A healthy adult white rat of about 200-250 gm. weight, when starved absolutely, (*i.e.*, deprived both of food and water) loses weight on the average at about 15-16 grammes per day, and dies as a rule on the fifth or sixth day.⁷

(2)). Rats treated by the daily injection of 5 to 10 c.c. of normal serum into the loose subcutaneous tissue lose on an average only about 8-9 gm. per day, and may live as long as several weeks, without other food of any sort.

Tables 1 and 2 illustrate the usual fall in weight in white rats consequent on starvation, together with the modifications induced by the administration of serum. The two series of animals were kept under precisely parallel conditions.

⁷ In cold weather starved rats will not infrequently die in three or four days.

TABLE I.—RATS STARVED ABSOLUTELY.

August 12			13	14	15	16	17	18	19
Rat 1	...	gm. 230	gm. 210	gm. 200	gm. 188	gm. 169	gm. Dead	—	—
Rat 2	...	266	243	224	211	Dead	—	—	—
Rat 3	...	227	209	196	186	173	Dead	—	—
Rat 4	...	271	255	240	226	215	Dead	—	—

TABLE II.—SERUM-FED RATS.

August 12			13	14	15	16	17	18	19
Rat 5	...	gm. 255	gm. 247	gm. 240	gm. 232	gm. 226	gm. 221	gm. 213	gm. 207
		Serum 10 cc.	5 cc.	5cc.	10 cc.	5 cc.	2 cc.	5 cc.	5 cc.
Rat 6	...	237	229	221	214	209	202	194	188
		Serum 10 cc.	5 cc.	5 cc.	10 cc.	5 cc.	2 cc.	5 cc.	5 cc.
Rat 7	...	288	279	271	272	255	250	244	235
		Serum 10 cc.	5 cc.	5 cc.	10 cc.	5 cc.	2 cc.	5 cc.	5 cc.
Rat 8	...	262	255	246	239	230	222	217	208
		Serum 10 cc.	5 cc.	5 cc.	10 cc.	5 cc.	2 cc.	5 cc.	5 cc.

On the eighth day, in this particular series of experiments, the treatment was stopped, as all the controls had died by the fifth

day ; Nos. 5, 6 and 7, and 8 subsequently recovered completely and had regained their normal bulk within a fortnight. I have succeeded in prolonging the life of a starved rat on three occasions for fourteen days, and once for as many as twenty days, by means of injections of serum.

Mice also bear the treatment very well, but the results are not quite as satisfactory as with rats. The following charts exhibit the sustaining effects on the former animals.

TABLE III.—MICE STARVED ABSOLUTELY.

July 26		27	28	29	30	31	Aug. 1
Mouse 1	gm. 16·6	gm. 15·0	gm. 13·4	gm. 12·4	Dead	—	—
Mouse 2	14·8	13·3	12·0	Dead	—	—	—
Mouse 3	16·2	15·0	13·2	Dead	—	—	—

TABLE IV.—SERUM-FED MICE.

July 26		27	28	29	30	31	Aug. 1
Mouse 4	gm. 15·8	gm. 15·0	gm. 14·3	gm. 13·8	gm. 13·4	gm. 13·0	gm. 12·3
Serum 1 cc.		1 cc.	·5 cc.	1 cc.	1 cc.	1 cc.	—
Mouse 5	16·3	15·9	15·0	14·0	13·5	12·7	Dead
Serum 1 cc.		1 cc.	·5 cc.	1 cc.	1 cc.	1 cc.	—
Mouse 6	16·4	15·7	14·9	14	13·3	12·9	12·3
Serum 1 cc.		1 cc.	·5 cc.	1 cc.	1 cc.	1 cc.	—

As has been already mentioned, the strictly vegetable feeders, *e.g.*, guinea-pigs and rabbits, tolerate the method comparatively badly, though even with them the diminution in weight is less, and the prolongation of life is greater, than with the controls.

The above experimental results are sufficiently striking, but for several reasons I do not think they exhibit the nutritive effects of serum in the best possible light. From an experience of many hundreds of laboratory animals I am confident that the mere shock and disturbance of handling a small rodent and injecting distilled water are quite sufficient to produce some temporary loss of weight; and when such shock is repeated daily, it is obvious that a disturbing factor is introduced which operates prejudicially against the success of the experiment. By employing hibernating animals during the winter time, however, we secure ideal subjects for this investigation. The dormouse, for instance, when quite torpid and thoroughly settled down, can be submitted to various operative procedures without giving any evidence of its equilibrium having been disturbed. Its changes in weight from day to day, though small and only detectable by a delicate chemical balance, are constant and uniform. This steady loss, which is borne by the fatty and "reserve" tissues, eventually tells; for after a month or two's torpor the creature begins to look shrunken and wasted. By means of serum injections, however, the weight can be maintained through a whole winter without taxing the animal's tissues at all, and its initial condition of plumpness is thus preserved unaltered. The following details of one experiment, which was most carefully controlled, bring out these facts very clearly.

Four hibernating dormice were weighed every day for nearly a month. They were found to progressively diminish in weight at an almost perfectly uniform rate per animal, *viz.* :—

Dormouse 1 lost 14 mgms. per day for 23 days.

„	2	„	15	„	„	„
„	3	„	30	„	„	„
„	4	„	14	„	„	„

TABLE V.

Date.	Dormouse 1	Dormouse 2	Dormouse 3	Dormouse 4
1897.	gm.	gm.	gm.	gm.
December 14	9·206	10·513	11·831	10·337
" 15	9·192	10·498	11·811	10·323
" 16	9·188	10·483	11·780	10·310
" 17	9·173	10·467	11·851	10·296
" 18	9·157	10·453	11·721	10·280
" 19	9·143	10·438	11·691	10·270
" 20	9·130	10·423	11·668	10·256
" 21	9·115	10·409	11·637	10·242
" 22	9·101	10·392	11·605	10·228
" 23	9·085	10·377	11·575	10·213
" 24	9·074	10·363	11·544	10·199
" 25	9·060	10·349	11·516	10·184
" 26	9·043	10·334	11·486	10·170
" 27	9·028	10·320	11·456	10·155
" 28	9·014	10·305	11·435	10·141
" 29	9·000	10·290	11·402	10·126
" 30	8·985	10·274	11·372	10·111
" 31	8·972	10·260	11·340	10·097
1898.				
January 1	8·959	10·245	11·311	10·083
" 2	8·945	10·230	11·281	10·070
" 3	8·930	10·214	11·252	10·056
" 4	8·920	10·199	11·222	10·042
" 5	8·904	10·185	11·190	10·027

On January 5th, dormouse (1) received an injection of about 0·75 c.c. of normal serum (measured with a pipette); dormouse (2) received 0·5 c.c.; dormouse (3) 0·25 c.c.; dormouse (4) being kept as a control. Before injection they weighed respectively:—

No. 1. 8·904 gm.

No. 2. 10·185 gm.

No. 3. 11·190 gm.

No. 4. 10·027 gm.

The liquid was introduced beneath the loose subcutaneous tissue of the back, and the creatures were not awakened, or in any way disturbed by the operation. After injection they were immediately re-weighed and were found to be exactly—

No. 1. 9·625 gm.

No. 2. 10·670 gm.

No. 3. 11·431 gm.

The next chart (VI) indicates the effects upon the animals during the subsequent twenty-three days.

TABLE VI.

Date.		Dormouse 1	Dormouse 2	Dormouse 3	Dormouse 4
		gm.	gm.	gm.	gm.
January	6	9·625	10·670	11·431	10·027
"	7	9·599	10·640	11·370	10·012
"	8	9·571	10·611	11·319	9·998
"	9	9·546	10·582	11·263	9·984
"	10	9·520	10·551	11·219	9·970
"	11	9·495	10·521	11·179	9·955
"	12	9·472	10·492	11·139	9·940
"	13	9·450	10·463	11·101	9·926
"	14	9·425	10·432	11·080	9·912
"	15	9·401	10·406	11·051	9·896
"	16	9·380	10·384	11·020	9·881
"	17	9·359	10·360	10·995	9·866
"	18	9·339	10·341	10·965	9·848
"	19	9·321	10·320	10·938	9·833
"	20	9·302	10·299	10·909	9·817
"	21	9·284	10·279	10·879	9·805
"	22	9·266	10·261	10·848	9·791
"	23	9·248	10·242	10·817	9·775
"	24	9·230	10·223	10·786	9·760
"	25	9·213	10·206	10·759	9·756
"	26	9·194	10·190	10·730	9·742
"	27	9·176	10·173	10·701	9·728
"	28	9·160	10·160	10·674	9·715
"	29	9·141	10·142	10·645	9·701

Now, had no serum been given, and had all the animals continued to decrease in weight at the same rate as during the preceding twenty-three days, then on January 29th.—

Dormouse 1 would have weighed 8·602 gm.

" 2 " " " 9·857 "

" 3 " " " 10·539 "

whereas they really were 9·141 gm., 10·142 gm., and 10·645 gm., respectively. A fortnight later (February 10th) a further

re-weighing showed that the actual, as compared with the estimated weights, were as follows :—

	ACTUAL WEIGHT.	ESTIMATED WEIGHT.
Dormouse 1.	8·896 gm.	8·506 gm.
„ 2.	9·902 „	9·647 „
„ 3.	10·222 „	10·119 „
„ 4.	9·501 „	9·505 „

That is to say, in nearly six weeks dormouse (1), which received ·75 c.c. of serum, had only lost ·008 gm. instead of ·498 gm. ; dormouse (2), which received ·5 c.c., ·283 gm. instead of ·538 gm. ; and dormouse (3), which received ·25 c.c., ·968 gm. instead of 1·071 gm. ; whilst the weight of dormouse (4), which received no serum at all, was within ·004 gm. of the estimated weight. The full significance of these figures is seen in the fact that whereas dormouse (4) (no serum) and dormouse (3) (insufficient quantity) were shrivelled and wasted in appearance at the end of the experiment, there was no appreciable difference to be detected in dormouse (1), and very little in dormouse (2).

Further investigations, as might be expected from the above results, showed that by repetition of the injection at suitable intervals, the normal weight and condition of a dormouse at the beginning of hibernation could be maintained till spring without change.

These experimental data seems to amply justify the application of subcutaneous serum-feeding to man in conditions where nourishment cannot be retained by mouth or rectum, or where the pathological state of the alimentary canal renders it inexpedient or impossible to administer food *per vias naturales*. Such conditions are very numerous, and include gastric ulcer with hæmatemesis and rectal irritability ; severe cases of enterica ; acute or chronic gastro-enteritis, especially if associated with pronounced marasmus ; prolonged vomiting, following operations and anæsthetics ; hernia and intestinal obstruction cases ; gynæcological and puerperal cases with vomiting and diarrhœa ; as well as many other analogous affections. During the past twelve months I have supplied normal serum for feeding purposes in over seventy cases, nearly forty of which have been at Guy's Hospital. The nature

of the conditions in which the serum has been employed has been very varied, and the reports received have been very encouraging. I do not yet feel, however, in a position to put forward a definite statement as to its clinical value. There are two methods by which the value or otherwise of a new remedy may be determined, viz., by examining the results according to the recognized canons of the science of statistics, and by taking the individual impressions and general consensus of opinion of those using it. Clinical impressions, of course, cannot furnish any strict scientific proof, but in the present instance statistical evidence is clearly not reliable, or even obtainable, because there exists no basis of comparison between the comprehensive collection of heterogeneous cases and any other preceding or parallel series. In forming an estimate of the nutritive value of normal serum in human therapeutics, we must be content to accept the opinions of the clinicians who have employed it. In this paper attention will be confined to a purely experimental study of the question, but it may be said that the treatment is most likely to prove valuable in conditions following operations, where the patient needs to be supported during a few critical days of weakness, collapse, and inability to take nourishment; in typhoid fever; and in marasmic infants going downhill. It has also been used with remarkable success at the Brook Fever Hospital in a number of cases of wide-spread post-diphtheritic paralysis, where the well-known associated continuous vomiting had reduced the patients to a condition of emaciation and practical starvation. In fact in one case a child of five received nothing whatever by mouth or rectum for eight days, and was kept alive during this time entirely by large injections of normal serum. Indications as to dosage and other points to be observed in the treatment will be derived from further analysis of the effects of serum upon the animal economy.

INFLUENCE OF FOREIGN SERUM UPON THE HEALTHY METABOLISM.

The modifications which serum induces in the metabolism can be best studied by measuring the resultant variations in nutrition and excretion. Now the proteid ingredients of serum introduced

into the body may be either (1) immediately or gradually excreted by the urine in the same form as that in which they entered the system, or (2) changed within the tissues and tissue-juices. In the latter case, they may be either (a) broken up at once into simpler nitrogenous compounds, and excreted and got rid of, though in a different chemical state from that in which they entered, or (b) utilized in the requirements of the tissues, *i.e.*, assimilated. It is quite certain that after an injection of normal serum the contained albumen does not pass out as such through the kidneys, unless enormous and toxic doses forming a large fraction of the body-weight are given.⁸ It is equally certain from the experiments already described that true assimilation must occur. The question as to its ultimate destiny, however, is complicated by certain subsidiary effects of the serum upon the tissues themselves.

In 1895, Arloing,⁹ before the Soc. Nat. de Méd. de Lyons, stated that by subjecting a number of young guinea-pigs to daily small injections of normal serum, a decidedly prejudicial effect upon their growth and nutrition resulted, the treated animals failing to gain weight as rapidly as the controls. I have repeated his observations in the following manner. Three series of guinea-pigs, about five to six weeks old, were taken. Each set contained five animals, and their total weights were as follows:—Lot (1) 2,420 gm., Lot (2) 2,518 gm., Lot (3) 2,485 gm. For three weeks, August 2nd to 24th, each animal in Lot (3) received 0·5 c.c. of normal serum hypodermically; to those in Lot (2) was given 0·5 c.c. of distilled water, in the same manner, while those in

⁸ That ordinary therapeutic doses of normal serum do not produce albuminuria in animals has been shown by Zagari and Calabrese, ("Ulteriori ricerche clin. e sperimentale sulla tossina ed antitossina difterica," Naples, 1895; and Giorn. internaz. delle Scienze mediche, XVIII), by Poix, Thèse de Paris, 1896, No. 351, p. 83, by Gouget (Compt. Rend. de la Soc. de Biol., 6 Aug., 1897), and by various other authors.

In the experiments on the elimination of urea in rabbits after serum administration (*vide* p. 255). I could detect no trace of albumen in the urine during the whole of the week following inoculations with 2, 5, 10, and 20 cc. respectively. I have found that in the rabbit at least 30 cc. of serum per kilo of animal are required in order to excite albuminuria; whilst the rat can assimilate quantities representing $\frac{1}{4}$ th of the entire body-weight before any of the albumen manages to find its way through the renal filter.

⁹ Lyon Méd. T. 79, 20 May, 1895, p. 151.

Lot (1) were used as controls. On August 24th, the combined weight of the five animals composing Lot (1) was found to be 4,460 gm.; that of Lot (2) 4,268 gm., and that of Lot (3) 3,915 gm.

In other words—

Lot (1) exhibited an increase in weight of 81 % over Aug. 2.

Lot (2) " " " 69 % " "

Lot (3) " " " 57 % " "

It is therefore clear that the daily shock of handling and injecting with distilled water had retarded the growth of the guinea-pigs in Lot (2); but when all allowance is made for this, it is certain that the creatures which received the serum did not increase in weight nearly as rapidly as those left alone.

Further, if an adult rabbit whose weight is stationary, is injected with a small quantity, say 1 or 2 c.c. of serum, it will not infrequently be found to diminish slightly in weight during the next few days. It is very difficult to be quite sure about same differences in animals, because a matter of 10 or 15 grammes between one day and the next may depend upon the relative fulness of the stomach, rectum, or bladder on the two occasions. Still I have found, as a general rule, both in rabbits, guinea-pigs, and rats, that a tolerably constant result of the inoculation of a minute quantity of serum is a slight loss in weight.

Examination of the urine indicates that these results are really due to increased rapidity of tissue change in the animal, as evidenced by a corresponding increase in the nitrogenous and other constituents of the urine. Careful quantitative investigations also furnish the key to the paradox that whilst large doses of serum act as a food towards a starving animal, small doses may actually cause loss of weight in the healthy. These experiments were carried out in the following manner :—

Four rabbits, A, B, C, and D, of approximately the same size, were taken, and each animal was confined separately in a block-tin cage, tilted to such an angle that all the urine emitted gravitated to a gauze covered aperture in one corner, whence it was collected in a glass beaker. During the continuance of the experiment, the animals were supplied each day with food of precisely the same quantity and nature, in order that variations in the excretion of urea might not be introduced by differences in the amount of

proteid ingested. For ten days the total daily amount of urea was estimated for each animal. (Table VII). Rabbit A then received 2 c.c. of normal serum beneath the skin of the abdomen, Rabbit B, 5 c.c., Rabbit C, 10 c.c., and Rabbit D, 20 c.c. For ten days more the estimations were continued, and it was found that in every case a very striking increase in the amount of urea had occurred, the increase being greatest on the 2nd, 3rd, or 4th days after the injection. (Table VIII).

From these tables we can obtain a considerable amount of information. In the first place, we gather that even so small a quantity of serum as 2 c.c. causes a very marked rise in the urea elimination. This is clearly not due to the mere conversion of the albumen into its equivalent quantity of urea. Normal horse-serum contains about 80 parts of albuminous bodies (serum-albumen, serum-globulin, etc.) in 1,000.¹⁰ In the case of these four rabbits, then, (A) received only .16 gm. of proteid, (B) .4 gm., (C) .8 gm., and (D) 1.6 gm. Now, if *all* the introduced albumen had reappeared in the urine as urea, the total increase of the latter should not have exceeded .0548 gm., .134 gm., .267 gm., and .534 gm. respectively; whereas we see by the tables that on the 2nd, 3rd and 4th days alone, after the injection, the increase over the mean of the preceding ten days was no less than 2.307 gm., 2.062 gm., 3.354 gm. and 2.305 gm. respectively. These figures prove conclusively that the increased elimination of urea cannot be simply due to the transformation of the *serum-proteids* into their corresponding excretory products, but that actual acceleration of tissue waste (katabolism) must have occurred with the oxidation of *body-proteids*. This fact is doubtless intimately related to the causation of the slight pyrexia which usually follows an injection of serum. (*vide* p. 264).

It will be observed that the intensity of the katabolic changes is by no means proportionate to the amount of serum injected. The quantity of urea excreted is not greater after the administration of 20 c.c. than after 2 c.c. If, therefore, only a very small dose of serum is given, the tissue destruction and consequent loss of weight will more than counterbalance the addition of the injected

¹⁰ The latest analyses, only just published (Szontagh and Wellmann, Deutsche Med. Woch. 7 July, 1898, No. 27, p. 423) give the percentage of albumen in horse-serum as varying between 7.4 and 8.1.

TABLE VII.—TOTAL UREA FOR TEN DAYS PRIOR TO INJECTION.

Date.	A.			B.			C.			D.		
	Total quantity of urine.	Urea in grammes per cc.	Total daily quantity of urea.	Total quantity of urine.	Urea in grammes per cc.	Total daily quantity of urea.	Total quantity of urine.	Urea in grammes per cc.	Total daily quantity of urea.	Total quantity of urine.	Urea in grammes per cc.	Total daily quantity of urea.
May 24	cc. 240	·010	gm. 2·40	cc. 205	·010	gm. 2·05	cc. 236	·011	gm. 2·596	cc. 165	·009	gm. 1·485
25	230	·011	2·53	215	·009	1·935	205	·012	2·460	160	·010	1·60
26	185	·0125	2·3125	215	·0085	1·825	178	·0135	2·403	175	·010	1·75
27	225	·010	2·25	200	·0105	2·10	230	·012	2·76	150	·010	1·50
28	250	·009	2·25	230	·008	1·84	245	·010	2·45	192	·008	1·536
29	192	·013	2·496	210	·0085	1·785	252	·010	2·52	165	·009	1·405
30	250	·011	2·750	200	·010	2·00	250	·0105	2·625	160	·010	1·60
31	260	·010	2·60	240	·0075	1·80	255	·010	2·55	160	·011	1·76
June 1	235	·010	2·35	195	·0105	2·0475	225	·012	2·700	180	·008	1·44
2	230	·011	2·530	215	·010	2·15	198	·012	2·376	155	·010	1·55
	Mean for ten days = 2·446 gm.			Mean for ten days = 1·953 gm.			Mean for ten days = 2·542 gm.			Mean for ten days = 1·570 gm.		

TABLE VIII.—TOTAL UREA FOR TEN DAYS SUBSEQUENT TO INJECTION.

Date.	A. (2 cc.)				B. (5 cc.)				C. (10 cc.)				D. (20 cc.)			
	Total quantity of urine.	Urea in grammes per cc.	Total daily quantity of urea.		Total quantity of urine.	Urea in grammes per cc.	Total daily quantity of urea.		Total quantity of urine.	Urea in grammes per cc.	Total daily quantity of urea.		Total quantity of urine.	Urea in grammes per cc.	Total daily quantity of urea.	
June	cc.		gm.		cc.		gm.		cc.		gm.		cc.		gm.	
3	205	·012	2·460		226	·009	2·034		250	·011	2·750		178	·010	1·78	
4	260	·011	2·860		230	·010	2·30		300	·012	3·600		200	·010	2·0	
5	270	·013	3·510		248	·0120	2·976		320	·0135	4·320		220	·012	2·640	
6	270	·0125	3·375		230	·0115	2·645		255	·012	3·060		225	·011	2·375	
7	250	·011	2·750		225	·010	2·25		275	·0 0	2·75		200	·010	2·00	
8	210	·012	2·520		200	·010	2·00		225	·011	2·475		160	·011	1·76	
9	200	·011	2·200		210	·0085	1·785		270	·010	2·70		210	·0085	1·785	
10	250	·0105	2·625		215	·009	1·935		240	·010	2·40		155	·011	1·705	
11	240	·010	2·40		200	·009	1·80		215	·012	2·58		145	·01	1·45	
12	255	·009	2·295		185	·011	2·085		244	·010	2·44		165	·009	1·485	

albumen. With larger, and especially with repeated doses, however, a point is reached when the quantity of albumen exceeds the loss, and a gain in weight results. In the starvation experiments this excess partly compensates for the deprivation of natural food.

The substance in serum which excites katabolism is not the albumen or globulin, because its effects are completely abolished by subjection to a temperature below the coagulating point of these bodies. Thus, if serum which has been heated for two hours to 65° C. is injected into an animal, no appreciable increase of urea follows, as is shown in table IX.

I have several times repeated this experiment with different quantities of heated serum, but have always failed to detect anything more than a trifling increase in the urea excretion. Indeed, I have twice found a slight diminution. On the other hand, "the total urinary nitrogen," estimated by Kjeldahl's method, is usually definitely greater. It seems probable, therefore, that none of the albumen of a serum-injection becomes converted into urea, but that some of it ultimately reappears in the urine in the form of nitrogenous bodies of more complex nature.

For feeding purposes there is a great advantage in giving "heated" serum in that the katabolism-stimulating substance being destroyed there is no tissue waste to be made good, and all the introduced proteid is absolute gain, so to speak. The pyrogenic effects are also abolished by a temperature of 65° C. (*vide* p. 265), although no visible result is produced on the serum by this treatment. It is therefore highly probable that the body responsible for the causation of the phenomena in question is of the nature of a ferment, and this supposition further explains why its effects are not proportional to the dose.

THE TOXICITY OF SERUM.

In considering the question of the administration of large quantities for feeding purposes in man we are bound to ask, "What is the limit of its safe employment, and which animal is the most suitable as a serum-yielder?" Numerous observations have established the fact that above a certain dose the serum of one animal exercises a direct and immediate toxic action upon

TABLE IX.—RABBIT E.

Urea excretion prior to injection.				Urea excretion following injection of 10 cc. heated serum.			
Date.	Total quantity of urine.	Urea in grammes per cc.	Total daily urea.	Date.	Total quantity of urine.	Urea in grammes per cc.	Total daily urea.
June 16	c.c. 245	·010	gm. 2·45	June 23	c.c. 260	·009	gm. 2·34
" 17	250	·009	2·25	" 24	260	·009	2·34
" 18	238	·010	2·38	" 25	240	·010	2·40
" 19	225	·011	2·475	" 26	245	·010	2·45
" 20	260	·009	2·34	" 27	210	·012	2·52
" 21	220	·012	2·640	" 28	215	·011	2·365
" 22	208	·012	2·496	" 29	225	·012	2·70
Mean daily excretion of urea prior to injection = 2·483 gm.				Mean daily excretion of urea subsequent to injection = 2·445 gm.			

another. This toxicity has been studied by several investigators,¹¹ but almost invariably by the following method. The serum is injected slowly and continuously into the marginal auricular vein of a rabbit (or into the saphena of a dog) until death ensues; and the exact quantity which has been given at this moment, expressed as the amount necessary to kill one kilogramme of animal, is termed "the coefficient of toxicity" of the particular serum under examination. Thus, if 60 c.c. of a certain liquid kills under these circumstances a rabbit weighing 1,500 grammes, its toxic coefficient is 40. The smaller the coefficient, therefore, the more dangerous is the serum.

Table X. exhibits the indices which have been given for the blood-serum of various animals by the authorities quoted below:—

TABLE X.

Bullock	...	9.2	...	(Guinard & Dumarest)
"	...	8	...	(Rummo & Bordoni)
"	...	6	...	(Uhlenhuth)
"	...	22.5	...	(Leclainche & Remond)
Dog	...	10.55	...	(Guinard & Dumarest)
"	...	21	...	(Mairet & Bosc)
"	...	24	...	(Roger)
"	...	38	...	(Leclainche & Remond)
Cat	...	13.5	...	(Guinard & Dumarest)
"	...	23	...	(Leclainche & Remond)
Calf	...	13	...	(Rummo & Bordoni)
"	...	25	...	(Leclainche & Remond)
Sheep	...	20	...	(Weiss)
"	...	26	...	(Leclainche & Remond)
"	...	11	...	(Uhlenhuth)
"	...	12	...	(Rummo & Bordoni)
Ass	...	117	...	(Guinard & Dumarest)
Horse	...	324	...	(Guinard & Dumarest)
"	...	119	...	(Leclainche & Remond)
"	...	95	...	(Zagari & Calabrese)
"	...	" over 60 "	...	(Uhlenhuth)

¹¹ *Vide* Guinard and Dumarest—*Compt. Rend. de la Soc. de Biol.* 7th May 1897, T. IV., p. 414; Roger,—*La Presse Médicale*, 8th June, 1895, p. 209; Uhlenhuth, *Zeitschr. für Hyg.* Bd. XXVI, Heft 3, 1897, p. 386; Rummo & Bordoni, *Tossisita del Siero del Sangue*, *Rif. Medica*, October, 1889; Rummo *Wiener Med. Woch.* 1891, pp. 830, 870 and 918; Leclainche et Remond, *Compt. Rend. de la Soc. de Biol.* 23rd December, 1893, p. 1037; Mairet & Bosc, *ibid.* 16th and 23rd June, 1894, pp. 487 and 543. Charrin, *ibid.* 1890, p. 697, and Zagari and Galabrese, *loc. cit.*

From these figures we learn that there is a scale of toxicity for the serum of different animals, that of the bullock being highly toxic to the rabbit, whilst that of the horse is only immediately so from the physical disturbances induced by the great bulk of fluid injected. I have said "immediately so," for as a matter of fact, with doses of 50 c.c. of horse-serum per kilo the rabbit or dog dies after a more or less prolonged interval. To obtain an idea of the true or "absolute" toxicity, the minimum lethal dose by the subcutaneous method must be ascertained, that is to say, the least quantity per kilo that will lead to death at any period more or less remote after the injection. The next Table (XI) shows the results which I have obtained by the latter test, the subject employed being in all cases the rabbit.

TABLE XI.

Bullock	...	...	...	6 c.c. per kilo.	
Dog	...	...	...	9 c.c.	„
Cat	...	...	...	10 c.c.	„
Calf	...	...	...	12 c.c.	„
Sheep	...	...	...	18 c.c.	„
Ass	...	...	...	25 c.c.	„
Horse	...	...	...	33 c.c.	„

In these experiments the subcutaneous method was chosen in preference to the intravenous, because we thereby approximate more closely to the conditions under which the agent is given in man.

It is seen, however, that though the actual fatal quantity of serum is in all cases less than is indicated by Table X, the respective positions of the different animals in the scale do not vary, whether immediate or subsequent death is taken as the criterion.

The scale represents the relative toxicity of various *sera towards the rabbit*, but it must not by any means be concluded that the figures are identical, or even approximately so, for any other species of experimental animal. Roger,¹² for example, states that the dog and the rabbit present no reaction following inoculation with quantities of bullock serum, which in proportion to the weight of the subject would be surely fatal for a guinea-pig,

¹² La Presse Médicale, 8th June, 1895, p. 209.

TABLE XII.

Serum of	Experimental Animal.	Fatal Dose.	Experimental Animal.	Fatal Dose.	Experimental Animal.	Fatal Dose.
Horse ...	Mouse ...	$\frac{1}{2}$	Rat ...	$\frac{1}{2}$	Rabbit ...	$\frac{1}{30}$
Ass ...	"	$\frac{1}{4}$	"	$\frac{1}{3}$	"	$\frac{1}{40}$
Sheep ...	"	$\frac{1}{2}$	"	$\frac{1}{4}$	"	$\frac{1}{65}$
Rabbit ...	"	$\frac{1}{4}$	"	$\frac{1}{9}$	"	$\frac{1}{5}$
Guinea-pig ...	"	$\frac{1}{8}$	"	$\frac{1}{8}$	"	$\frac{1}{40}$
Rat ...	"	$\frac{1}{8}$	"	$\frac{1}{3}$	"	$\frac{1}{80}$
Normal Saline Solution	"	$\frac{1}{2}$	"	$\frac{1}{2}$	"	$\frac{1}{5}$
Distilled Water ...	"	$\frac{1}{3}$	"	$\frac{1}{3}$	"	$\frac{1}{4}$
					Guinea-pig	$\frac{1}{25}$
					"	$\frac{1}{35}$
					"	$\frac{1}{25}$
					"	$\frac{1}{25}$
					"	$\frac{1}{5}$
					"	$\frac{1}{40}$
					"	$\frac{1}{5}$
					"	$\frac{1}{4}$

He further states that 6 c.c. of bullock serum will kill 1 kilogram of fowl, though 20 c.c. are without effect on the same weight of pigeon. I have examined this question very carefully, and the following table (XII), which summarises my results, shows that the same serum is poisonous to different animals in very different degrees. In this table, the killing power is expressed as a fraction of the body-weight.

In order to illustrate the manner in which this chart was compiled, a protocol of two series of constituent experiment is given in Tables XIII and XIV. The animals in the following series were specially selected so that their weight might be as uniform as possible.

TABLE XIII.—DETERMINATION OF FATAL DOSE OF HORSE-SERUM FOR THE RABBIT.

	Weight in grammes.	Dose.	Fraction of body-weight.	Result.
Rabbit 1	1540	150cc.	$\frac{1}{10}$	Died in 48 hours
" 2	1560	75cc.	$\frac{1}{20}$	" 4 days
" 3	1510	60cc.	$\frac{1}{25}$	" 16 days
" 4	1540	55cc.	$\frac{1}{28}$	" 3 weeks
" 5	1530	51cc.	$\frac{1}{30}$	" 4 weeks
" 6	1535	46cc.	$\frac{1}{33}$	Alive at end of 3 months
" 7	1568	39cc.	$\frac{1}{40}$	" "
" 8	1505	30cc.	$\frac{1}{50}$	" "

TABLE XIV.—DETERMINATION OF FATAL DOSE OF SHEEP-SERUM FOR THE MOUSE.

	Weight in grammes.	Dose.	Fraction of body-weight.	Results.
Mouse 1	16.4	8.2cc.	$\frac{1}{2}$	Died in 30 hours
" 2	16.6	5.5cc.	$\frac{1}{3}$	Alive at end of 2 months
" 3	16.0	4.0cc.	$\frac{1}{4}$	" "
" 4	16.8	3.7cc.	$\frac{1}{5}$	" "
" 5	16.3	2.7cc.	$\frac{1}{6}$	" "
" 6	16.0	2.0cc.	$\frac{1}{8}$	" "

From these results we are in a position to make several generalizations :—

- (1). Horse-serum is the least toxic of all animal sera.
- (2). It is practically non-toxic except in quantities which are far above the ordinary therapeutic doses—quantities, in fact, which represent large fractions of the body-weight ($\frac{1}{2}$ for the mouse and rat, $\frac{1}{3}$ for the guinea-pig, and $\frac{1}{5}$ for the rabbit and dog).
- (3). Omnivora are much less susceptible to the toxic substances in serum than purely vegetable feeders.
- (4). The serum from any given animal is practically innocuous, and without any deleterious action towards other animals of the same species, its toxicity being the same as that of normal saline solution.

The last statement is probably the enunciation of general biological law, for Pellizari,¹³ as well as Gilbert and Fournier,¹⁴ have demonstrated that in the case of man the injection of the serum of one human being into another leads to no toxic sequelæ of any sort, although as we shall see, pyrexia and exanthemata are the rule rather than the exception after the use of any “foreign” serum. Similarly, horse-serum injected into the calf, almost invariably excites toxic accidents analogous to those which are observed in man,¹⁵ whilst calf-serum, injected into another calf, never induces such effects.¹⁶

Although it must be admitted that experimental evidence does not warrant us in asserting that, because horse-serum is non-toxic to laboratory animals except in enormous doses, it is therefore absolutely harmless to man in the same degree, yet the facts above set forth justify a strong presumption in favour of its innocence of any really injurious or dangerous effects. Even if the human subject possesses a susceptibility as great as that of the rabbit, quantities of 200 to 250 c.c. could easily be given to infants of six months without overstepping the safety-line. *A priori* then, there

¹³ Giorn. ital. d. mal. Ven. 1894, XXIX, p. 399.

¹⁴ La Semaine Méd. 1895, No. 22, p. 181.

¹⁵ Ungvaer—Thèse de Paris, 1897, No. 141, p. 59.

¹⁶ Bèclère, Chambin & Menard, Annales de l'Inst. Pasteur, T. X., 1896, p. 573.

is no reason for hesitating to give large and adequate doses to human beings for feeding purposes. Experience in actual practice also has conclusively shown that no harmful results need be apprehended. Thus, to a marasmic baby of fourteen months 60 c.c. were given daily for five days; to a child of five months with post-diphtheritic paralysis 80 to 100 c.c. daily for eight days; and to an emaciated adult with gastric ulcer 120 c.c. daily for a week. All these patients ultimately recovered, and throughout exhibited no ill effects whatever, and no albuminuria was detected either during the treatment or subsequently.

The figures quoted in Tables X—XIII represent the toxicity of "fresh," or recent serum, *i.e.*, serum within three or four days of having been drawn from the living animal. Guinard and Dumarest¹⁷ have shown that a spontaneous attenuation of the poisonous properties occurs with lapse of time, so that, for example, the serum of a dog which had a killing power of 10·6 c.c. per kilo on the second day when conserved aseptically became reduced to—

17·8 c.c. on the sixth day.

44·2 c.c. on the ninth day.

86·7 c.c. on the twenty-third day, and

106·3 c.c. in five months.

I have confirmed these statements, and have further ascertained that the decrease in toxicity can be artificially hastened by heating to 65° C. for two hours, or to as near the coagulating point of the serum as is possible without bringing down any of the globulins. By repeating the heating on one or two occasions the toxicity is abolished, or reduced to its permanent fixed value. For instance, some sheep-serum was taken, the fatal dose of which (intravenously) was estimated accurately for the rabbit at 35 c.c. per kilo. After heating on a water-bath to the above temperature, it was re-tested, when the toxicity was found to have diminished to 68 c.c. per kilo. Similar treatment on the following day further reduced it to 98 c.c. per kilo.

It can be shown that the spontaneous attenuation of serum-toxicity does not occur if the liquid is allowed to remain in

¹⁷ Compt. Rend. de la Soc. de Biol. 7th May, 1897, p. 416.

contact with the clot. Indeed, under these circumstances the lethal power is often markedly increased after the first week, in some cases being doubled or even trebled by the end of the month. All these points, of course, have considerable bearing upon the method of preparation of normal serum for feeding purposes.

So far only the *lethal* power of the serum of one animal towards another has been considered. It is well-known, however, that following the use of different therapeutic sera certain mild toxic sequelæ are not infrequently observed. These affections must, for the most part be considered as inconveniences rather than as complications of any gravity. The conditions which have been described are (1) pyrexia, (2) various exanthemata, and (3) arthropathies. There cannot be the slightest doubt that these phenomena have no relation whatever to the specific qualities of an antitoxic serum, and in no way depend upon the treatment to which the serum-yielder has been subjected. They occur, as I shall show, whenever the serum of one healthy animal is transferred to *another of a different species*. We shall now briefly study their production, and the methods whereby we can minimize or abolish their effects.

(1). *Effects on thermogenesis*. The injection of a serum, whether normal or therapeutic, into an animal or man almost invariably provokes a certain degree of fever, varying from a few tenths of a degree to several degrees Fahrenheit. For purposes of convenience, the pyrexia may be divided into (*a*) that occurring within twenty-four hours of the injection ("précocé," Sevestre), and (*b*), that not occurring until after the lapse of five or fourteen days ("tardif"). Zagari and Calabrese,¹⁸ and Poix¹⁹ have shown that 5 c.c. of horse-serum causes a distinct rise of temperature of 1° to 1.5° C. in the rabbit after about six or seven hours. Hayem ("Le Sang") found that bullock-serum excited a transient febrile rise in the dog within eight or twelve hours. Rogers²⁰ demonstrated that serum from the horse, dog, or rabbit, when injected into guinea-pigs led to a thermic elevation of from .5° to 1.5° C.,

¹⁸ Loc. cit.

¹⁹ Thèse de Paris, 1896, No. 351, p. 98.

²⁰ Loc. cit. p. 209.

lasting however only a very short time. Chapin²¹ found that 12 c.c. of normal horse-serum sent up the temperature of the sheep (101° F.) to a point between 104° and 105° F. Mariet and Bosc²² showed that the injection of human-serum in feeble doses into the dog or rabbit led to a rise of .5 to 1.5° C. persisting for three or four hours. I have found on two occasions that goat-serum injected into both the horse and the ass provokes a rise from the normal (100.4° F.) to 102°—103°. Sevestre,²³ Bertin,²⁴ and Zagari and Calabrese²⁵ have found that in man 10 c.c. of normal horse-serum cause in the eight to twelve hours following injection a fugacious pyrexia, which passes off, leaving no ill effects. Amongst the serum-fed cases at Guy's, and elsewhere, a slight rise of temperature (99° to 100° F.) was often noticed within twenty-four hours after an injection of unheated horse-serum. (*Vide* Chart VI, p. 276). With sheep-serum, which was tried in a few earlier cases on account of the facility of procuring it in quantities, a very decided pyrexia was always observed after about six to seven hours. (*Vide* Chart V, p. 275).

Serum which has been left for a long time in contact with the clot possesses intensely pyrogenic properties towards animals (*vide* Chart III) p. 268), but even that which is poured off within twenty-four hours of coagulation has analogous, though less marked, qualities. Repeated heating to 65° C. completely destroys the fever-producing principle, and this was well exhibited in the following experiment. On September 12th four rabbits, A, B, C and D, were each inoculated with 10 c.c. of the same serum from a horse which had been bled three weeks previously. Rabbit A received the liquid which had been poured off from the clot twenty-four hours after the venesection, *i.e.*, directly it had begun to separate. To Rabbit B was given some of the same sample, which, however, had been heated on three successive occasions to 65° C. Rabbit C received serum which had been allowed to remain in contact with the clot during the three weeks, whilst D was also

²¹ N.Y. Medical Record, 23 Nov. 1895, Vol. 48, No. 21, p. 721.

²² Compt. Rend. de la Soc. de Biol. 16 June, 1894, p. 490.

²³ Bull. de la Soc. Méd. des Hôp. 29 March, 1895, p. 285.

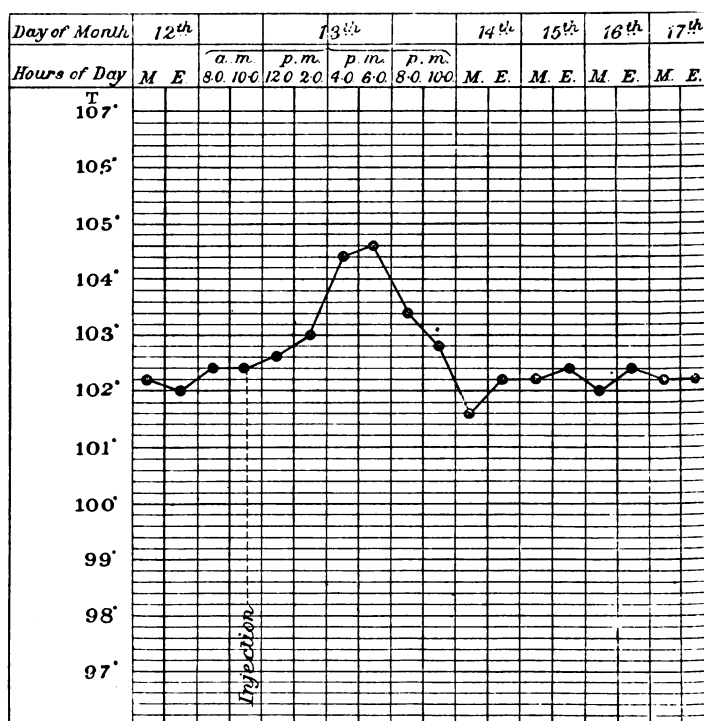
²⁴ Gaz. Méd. de Nantes, 1895, No. 4.

²⁵ Loc. cit.

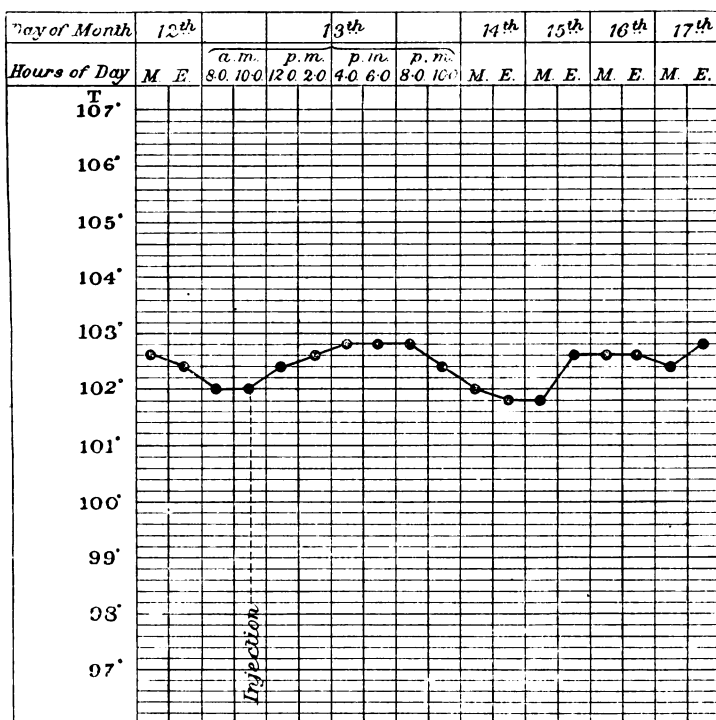
injected with this, which had been heated as before. After injection the temperatures were taken every two hours for twelve hours, and subsequently twice a day for four days.

RABBIT A.—CHART I.

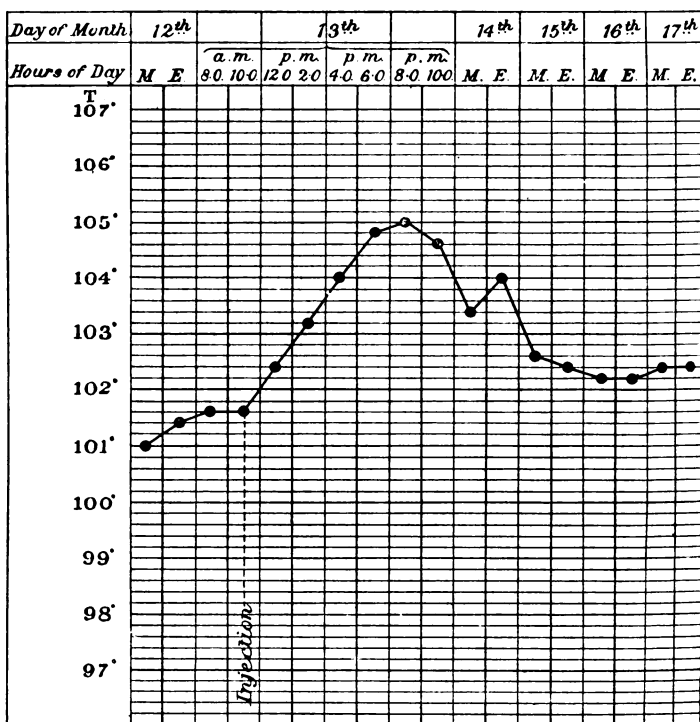
(Normal temperature of a rabbit varies from 100°-103° F.)



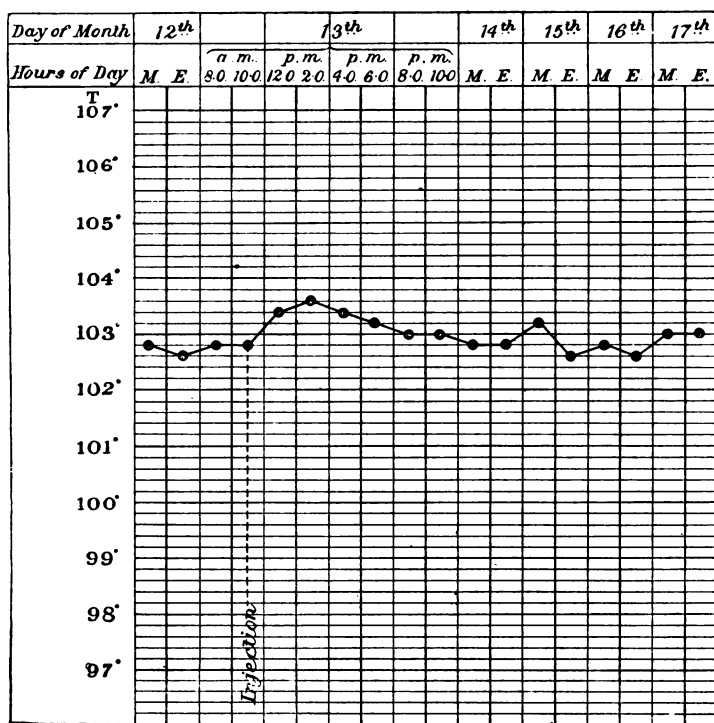
RABBIT B.—CHART II.



RABBIT C.—CHART III.



RABBIT D.—CHART IV.



These charts are merely representative of others that I have in my possession. They all indicate definitely that the heating has destroyed some pathogenic body. There is no doubt also that heated serum used upon man no longer excites any pyrexia, even in doses of 100 c.c., though 10 c.c. "crude" is sufficient to induce a febrile rise.

The pyrogenic substance can be precipitated from serum by absolute alcohol, acetone, and ammonium sulphate. If 50 c.c. be saturated with the latter salt, and the precipitate filtered off and washed, a normal saline extract of the residue will send up a rabbit's temperature in the same manner as the original liquid, whilst heating the solution will abolish the power.

We now come to the "late" pyrexia following serum administration. This is usually noticed in man in association with an exanthem, but either sequela may occur without the other, so that probably the two phenomena are due to distinct toxins. They are so closely connected, however, that they are most conveniently studied together.

Practically, every animal serum which has been tried upon man has been found to give rise to late febrile attacks accompanied or not by some form of cutaneous eruption. These affections may last for twenty-four hours to five or six days, and occur after an incubation period of from five days to three weeks. Triboulet²⁶ noticed a transient fever with urticaria seven days after injecting dog-serum. Feulard²⁷ saw urticaria twice in ten patients injected with normal dog-serum for lupus. Simonet²⁸ and Morel-Lavalée²⁹ both had urticaria and purpura after using dog-serum for tuberculosis. Toulouse³⁰ found fever plus eruption in five cases out of seven injected with normal dog serum, though Pinard³¹ noticed "no ill effects" in twenty-one children so treated. Tomasoli³² states that the normal serum of

²⁶ *Compt. Rend. de la Soc. de Biol.* 12 Jan., 1895, p. 19.

²⁷ *Bull. de la Soc. de Dermatol.* 9 July, 1892, p. 881.

²⁸ *Ibid.*

²⁹ *Thèse de Paris*, 1892, p. 27.

³⁰ *Bull. de la Soc. Méd. des Hôp.*, 6 March, 1896, p. 273.

³¹ *Ann. de Gynécologie*, Nov., 1891, p. 321.

³² *Loc. cit.*

both the lamb and the calf caused fever and urticaria in seventeen successive cases. Bécclère,³³ who inoculated both infants and adults with calf-serum, observed that urticaria generally appeared about nine days later. In my early cases already referred to, which received sheep-serum, pyrexia with exanthemata occurred in every instance, but usually there were no symptoms until twelve to fourteen days after injection. The eruptions were particularly severe, and were usually polymorphic in character. Marmorek³⁴ states that "serum of animals of the ovine species" usually causes troublesome erythemas and other skin affections.

Normal serum from the horse also excites these "late" accidents in man,³⁵ though apparently much less frequently than that of any other animal. The serum from every one of fourteen horses which I have observed has possessed the property of inducing both fever and rashes, though of all persons injected only a limited proportion proved susceptible to the poisons. Bécclère, Chambon and Ménard³⁶ have shown that by inoculating calves with horse-serum, erythemas and urticarias, accompanied by pyrexia, generally follow about the fifth day, and Ungvaer³⁷ states that the serum from certain individual animals was peculiarly liable to excite severe manifestations. I have no doubt from extended personal observation that the same fact applies in regard to its use on the human subject, but the type of rash certainly does not depend on the particular horse from which the serum was derived.

The substances to which these late sequelæ are attributable are not so easily destroyed as the other toxic bodies previously dealt with. They can be annihilated by heat, but the temperature necessary to destroy them with certainty is from 70° to 72° C., which is about the point at which some of the globulins are coagulated. It is difficult, therefore, to eliminate the injurious

³³ Bull. de la Soc. Méd. des Hôp., 10 Jan., 1896, p. 10.

³⁴ Ann. de l'Inst. Pasteur, T. IX., 1895, p. 607.

³⁵ Vide Sevestre (Bull. de la Soc. Méd. des Hôp. 29 March, 1895, p. 285); Bertin (loc. cit.); Zagari and Calabrese (loc. cit.); and Johennessen (*Journ. de Clin. et Thérap. Infant.*, 1896, p. 298).

³⁶ Ann. de l'Inst. Pasteur, T. X., 1896, p. 567.

³⁷ Thèse de Paris, 1897, No. 141, p. 61-63.

substances without at the same time detracting from the nutritive value of the serum by removing part of the albumen. With care and a good regulating thermostat, however, their destruction can be accomplished without any visible change in the liquid beyond the production of a very faint opalescence. The serum then becomes entirely free from any unpleasant after-effects. The pyrogenic property is destroyed at three or four degrees lower than the rash-producing, and this fact furnishes conclusive evidence that the causal agents are two separate and distinct substances.

The only other toxic effect of serum with which we have to deal is the production of arthropathies. Bécélère and Ungvaer³⁸ found that horse-serum injected into calves occasionally caused articular swelling. Johanessen,³⁹ who gave both normal and antidiphtheritic horse-serum to a parallel series of forty-one patients, had one case in each group where arthralgia subsequently developed. Tommasote⁴⁰ met with several cases of joint-pains and swelling after the use of normal sheep and calf-serum, and Janson reports two instances of mild arthritis following the injection of rabbit-serum. I have myself seen marked effusion and lameness produced in a horse as the result of a small injection of normal goat-serum. Here again, therefore, all the evidence points to the fact that mild arthropies may occur when any "foreign" serum is introduced into the economy.

Amongst the seventy odd serum-fed cases already referred to, no instance of arthritis or even arthralgia has so far been observed. Indeed, its complication in man after the use of horse-serum appears to be a very insignificant one, and from the Reports of the Superintendents of the Metropolitan Asylums Board⁴¹ the affection never goes beyond the stage of transient "joint-pains."

³⁸ Loc. cit.

³⁹ *Journ. de Clin. et Thérap. Infant.*, 1896, p. 298.

⁴⁰ Loc. cit.

⁴¹ Rep. of Superintend. of Met. Asylums Bd. on Use of Antitoxic Serum 1895, p. 26.

CONCLUSIONS.

(1). The fresh and healthy serum of any mammal, when transferred to a second animal of another species, exerts a series of effects, some of a beneficial, some of a toxic nature.

(2). The albuminous constituents are utilized by the economy, and under conditions of deprivation of natural food serum can be advantageously employed for a time as a substitute.

(3). Amongst the toxic substances found in serum the following are the most important :—

(a). A body which excites katabolism, and which leads to increased oxidation of tissue-proteids and to a great increase of urea in the urine.

(b). A substance which excites slight and fleeting pyrexia within a few hours of injection.

Both the preceding are destroyed by a temperature of 65°C , and are precipitated by alcohol, acetone, and ammonium sulphate. Possibly only one substance is responsible for both classes of effects.

(c). A substance which induces "late" pyrexia (*i.e.*, after a more or less prolonged incubation period), and which is destroyed at a temperature of 68° to 70°C .

(d). A rash-producing body, also capable of producing its effects only after an incubation period, and destroyed at 70° to 72°C .

(e). In certain sera (*e.g.*, those of the sheep and goat) a local reaction-producing substance, which leads to painful inflammatory induration at the site of inoculation. This body is analogous or possibly identical with the ichthyotoxin of Mosso,⁴² a poison occurring in the blood of fishes (eels) and many of the Sauropsida. It is readily destroyed by a temperature of 65°C , and can be precipitated by ammonium sulphate.

(4). Normal serum can thus be deprived of all its noxious qualities, and can then be used for feeding purposes in man. Horse-serum is the most suitable for this object, as it can be

⁴² Archiv für Experim. Path. und Pharmakologie Bd., XXV., 1888, p. 111.

easily obtained, and is less toxic than any other known animal serum. Enormous quantities of the prepared liquid can be given without risk. Doses which have been proved useful in practice, and at the same time harmless, are as follows :—For an infant, 30 to 40 c.c. ; for a child, 60 to 80 c.c. ; and for an adult, 100 to 120 c.c. ; repeated according to the exigencies of the case. If we keep within one-fortieth to one-fiftieth of the body-weight, we can hardly overstep the limits of safety. If it is intended to administer repeated daily doses, the most satisfactory plan is to inject the liquid into the loose subcutaneous tissue of, say, one loin on the first occasion, the opposite loin on the second, then into either axilla, then between the shoulder-blades, and so on, thus ringing the changes and giving each spot a few days' rest before practising a second inoculation at the same place.

CHART V.

Showing transient pyrexia in marasmic infant resulting from two injections of normal sheep-serum.

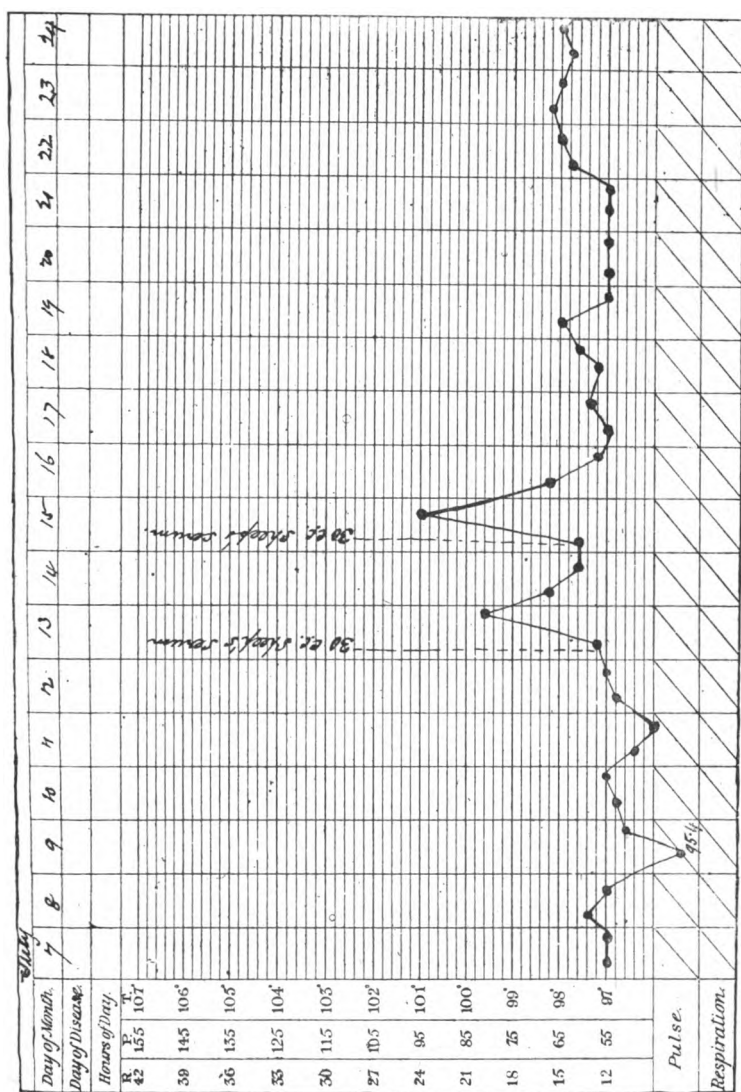
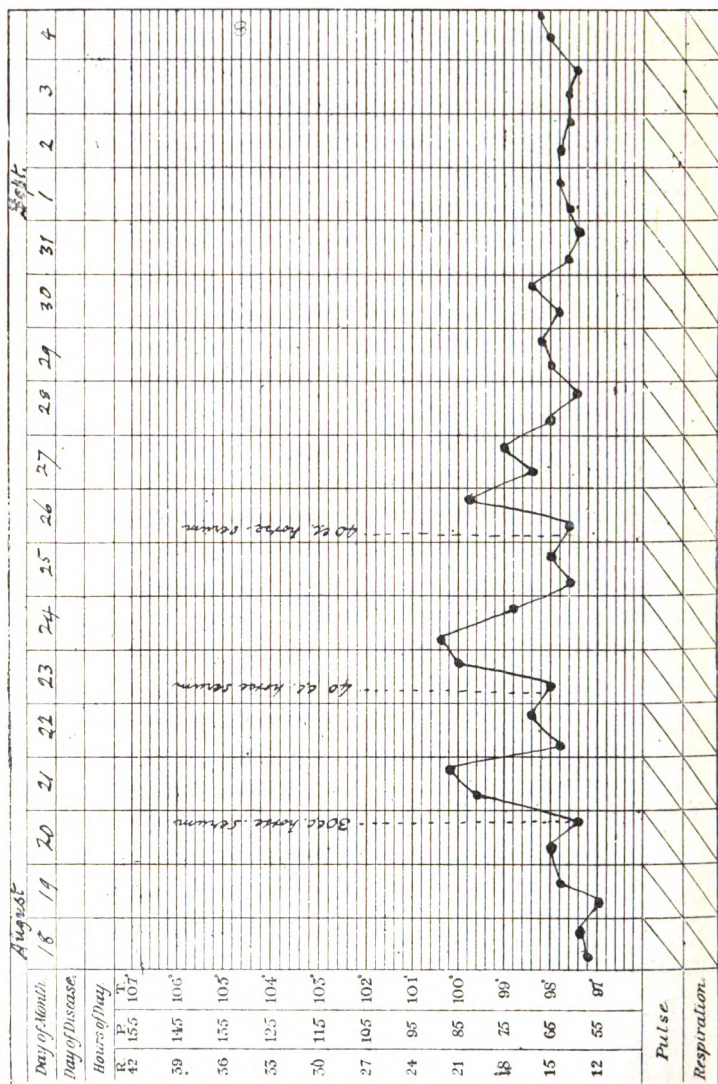


CHART VI.

Showing transient pyrexia in child of 5 resulting from injections of unheated normal horse-serum.



LIST OF PREPARATIONS RECENTLY ADDED TO THE MUSEUM.

BY LAURISTON E. SHAW AND E. COOPER PERRY.

18 Calcareous Gumma of the Testis.

A testis of normal size laid open to show at its upper part a rough calcareous nodule measuring rather more than half an inch in diameter. The rest of the organ is converted into dense fibrous tissue.

William J., æt. 57, was admitted under Mr. Howse for an epitheliomatous stricture of the œsophagus, and died on the following day from broncho-pneumonia. There were scars upon his wrist and forehead. *See Insp.*, 1891, No. 316.

163 Strangulation of the Testis.

A testis with a portion of the spermatic cord, removed by operation, and mounted to show the gland and the cord swollen and engorged with blood. The body of the testis is blackened.

John M., æt. 27, was admitted under Mr. Howse, in 1892, for pain in the left testicle, which came on suddenly while he was at work on the preceding day. On admission the testis and cord were noticed to be greatly swollen and very tender. The lymphatic glands in the groin were enlarged. An incision was made into the tunica vaginalis and it was found that the testis had become twisted upon itself in the axis of the cord "three times round." The organ was removed and the patient was discharged well, five weeks after the operation. *See Surgical Reports*, 1892, Case 137.

179 Chronic Hydrocele.

The sac of a hydrocele, measuring five inches in length, laid open to show its walls to be thick and fibrous and the testis to be firmly adherent by its posterior half to the lower and hinder part of the sac. The hydrocele extends rather more than two inches along the spermatic cord.

William D., æt. 62, was admitted under Mr. Howse for injuries received by falling from a roof, and died the following day. *See Insp.*, 1892, No. 406.

220 Round-celled Sarcoma of the Testis.

A testis, somewhat enlarged, and laid open to show at its lower part an encapsuled mass of growth of the shape and size of the normal organ. The growth, which is soft and hæmorrhagic, is dotted over with numerous small cysts. Histologically the malignant deposit has the characters of a round-celled sarcoma.

John A., æt. 47, was admitted under Mr. Durham, in 1893, for a painful swelling of the left testis of five months' duration. The testis was excised and the patient was discharged well twelve days later. *See Surgical Reports*, Vol. 163, Case 107.

238 Carcinoma of the Testis.

A testis injected and divided by sagittal section. The organ is enlarged so as to measure three inches in length and is firmly adherent to the tunica vaginalis, the sac of which is obliterated except at its upper end. The epididymis and body of the testis are both uniformly infiltrated by a spheroidal-celled carcinoma with scanty stroma.

John C., æt. 38, was admitted under Mr. Jacobson, in 1893, for a painless, nodular, swelling of the left testis, which had been first noticed three years previously. The testis was excised and the patient was discharged well five weeks after the operation. *See Surgical Reports*, Vol. 167, Case 23.

260 Hydrocele of the Spermatic Cord.

A thin-walled globular cyst about an inch in diameter, which was dissected from the structures forming the spermatic cord.

Charles J., æt. 3, was admitted under Mr. Davies-Colley, in 1893, for an oval fluctuating swelling in the right groin, which was found to be irreducible and translucent. The cyst was dissected from the surrounding tissues, and the patient was discharged well a fortnight later. *See Surgical Reports*, Vol. 165, Case 286.

281 Spindle-celled Sarcoma of the Testis.

A testis measuring five inches in length and uniformly infiltrated by growth which forms nodular prominences upon its surface. The cut section shows the deposit to be in many parts darkened by extravasated blood. The coverings of the organ are greatly thickened, and the cavity of the tunica vaginalis is obliterated. Histologically the growth is a spindle-celled sarcoma.

Presented by MR. SYMONDS, 1893.

331 Gummatous Testis.

A testis considerably enlarged, and divided to show its substance entirely replaced by nodular masses of firm yellow material with interlacing bands of fibrous tissue. The tunica vaginalis is adherent, and on the reverse of the specimen several sinuses are apparent in the skin of the scrotum.

Joseph S., æt. 44, was admitted under Mr. Howse, in 1894, for a painless swelling of the right testis, associated with discharging sinuses in the scrotum. There was a history of gonorrhœa 25 years previously, but none of syphilis. Some months before admission a swelling appeared in the right clavicle and subsided under treatment. The testis was removed, and the patient was discharged well one month after the operation. *See Surgical Reports*, Vol. 170, Case 147.

334 Syphilitic Orchitis.

A testis measuring three and a half inches in its longest diameter, laid open to show the appearances of syphilitic orchitis. The parenchyma of the organ is almost entirely replaced by a dense fibrous material in which are embedded yellow masses of gummatous deposit. A section through the globus major shows that a similar change has affected the epididymis. On the reverse of the specimen the surface of the organ is seen to be somewhat nodular; the tunica vaginalis is neither thickened nor adherent.

James B., æt. 77, was admitted under Mr. Lucas, in 1894, for a painless swelling of the left testis, which had been slowly growing for four months. He had had syphilis 50 years before, and had suffered from no illness of any kind since. The testis was removed, and the patient was discharged well one month after the operation. *See Surgical Reports*, Vol. 172, Case 219.

343 Hydrocele.

A vertical section through a right testis and its tunics, showing a small vaginal hydrocele, and above it, and completely separated from it, the lower end of the sac of an inguinal hernia.

David B., æt. 67, was admitted under Mr. Jacobson, in 1894, for an inguinal hernia on the right side, associated with a small hydrocele. An operation for the radical cure of the hernia was performed, and at the same time the testis was excised. The patient was discharged well two months after the operation. *See Surgical Reports*, Vol. 174, Case 57.

357 Alveolar Sarcoma of the Testis.

A testis somewhat enlarged and partially infiltrated by a white deposit seen on section to consist of soft nodules of various sizes, separated from each other by strands of a fibrous-looking material. Histologically the growth is a large round-celled sarcoma, the stroma of which presents an alveolar arrangement. The epididymis appears to be normal.

Presented by Mr. GOLDING-BIRD.

371 Alveolar Sarcoma of the Testis.

A testis enlarged so as to measure three inches in length and laid open to show the gland occupied by closely aggregated nodules varying in size from a line to half an inch in diameter. The nodules are of soft consistency and have undergone less contraction from the effects of the alcohol in which the preparation is mounted than the testicular stroma. They form prominent rounded elevations. Histologically the growth is a large round-celled sarcoma with alveolated stroma.

Robert F., æt. 26, was admitted under Mr. Golding-Bird, in 1894, for a swelling of the right testis, which had been noticed seven months. It was tender on manipulation. There was some thickening of the cord. The testis was excised, and the patient was discharged in good health three weeks later. *See Surgical Reports*, Vol. 173, Case 169.

372 Hæmatocele of the Spermatic Cord.

A testis with its coverings divided to show at the lower end of the spermatic cord a fibrous-walled sac, measuring

two inches in length and partially filled with recent blood-clot. There is also a small vaginal hydrocele.

Patrick S., æt. 48, was admitted under Mr. Davies-Colley, in 1894, for a painful swelling on the left side of his scrotum which had been first noticed seven months previously. The scrotum was tapped, and about two ounces of clear fluid withdrawn, after which a hard swelling remained. This, together with the testis, was excised, and was found to consist of the thick-walled sac, filled partly with translucent gelatinous material, and partly with a grumous fluid composed of blood and pus. See *Surgical Reports*, Vol. 171, Case 210.

471 Cyst of the Tunica Vaginalis.

A thin-walled cyst measuring rather more than an inch in diameter. The flattened and roughened surface of the sac corresponds to its attachment to the parietal layer of the tunica vaginalis. It is stated that the cyst was connected neither with the testis nor the epididymis.

Joseph R., æt. 24, was admitted under Mr. Lucas, in 1895, with a varicocele and a swelling in the course of the spermatic cord. The cyst was dissected from the surrounding tissues and the varicocele was excised. The patient was discharged well three weeks after the operation. See *Surgical Reports*, Vol. 178, Case 249.

528 Tuberculous Testis.

The half of an injected testis showing the body of the organ uniformly infiltrated with yellowish material. The sac of the tunica vaginalis is obliterated, and its parietal layer, which in the recent state was exposed by ulceration of the scrotum, is greatly thickened and covered by granulation tissue. The epididymis is much enlarged by caseous deposit.

From a man, æt. 23, who had suffered from a painful enlargement of the right testis. Some months after the onset of symptoms suppuration supervened, an abscess opened externally, and the body of the organ was extruded from the scrotum. Mr. Bryant removed the testis with a portion of the spermatic cord, and the patient made a good recovery.

Presented by Mr. BRYANT, 1892.

565 Abscess of the Epididymis.

A testis laid open from behind to show the epididymis greatly enlarged and thickened by inflammatory material. At the lower part is seen a small cavity which in the recent

state contained pus. On the reverse of the specimen is displayed the sac of a small hydrocele.

George G., æt. 55, was admitted under Dr. Taylor for bronchitis and emphysema, associated with stricture of the urethra. He died seven weeks after admission, having suffered for the last sixteen days from rigors and a painful swelling of the epididymis. At the autopsy the kidneys were found to be hydronephrotic, and there was pyelo-nephritis. See *Insp.*, 1889, No. 21.

573 Carcinoma of the Testis.

A testis partially divided to show at its upper end a white encapsuled growth measuring an inch in diameter. Histologically it is a spheroidal-celled carcinoma with scanty stroma.

Presented by Mr. JACOBSON, 1896.

574 Cyst with Retained Testis.

A thin-walled cyst about as large as a pigeon's egg which was connected with an undescended testis.

George E., æt. 14, was admitted under Mr. Howse, in 1895, for a swelling in the right inguinal region. It was translucent and irreducible. The right testis was not felt in the scrotum. The swelling was exposed and found to consist of an undescended testis together with the cyst which forms the preparation. The cyst was situated within the cavity of the tunica vaginalis, above and in front of the testis. It was excised, and the testis after being freed from its attachments was placed in the scrotum. See *Surgical Reports*, Vol. 176, Case 113.

575 Gummata of the Testis.

The half of a left testis, the cut surface of which shows several gummatus nodules projecting from the fibrous body of the organ. The tunica vaginalis is closely adherent, much thickened, and is of almost cartilaginous hardness. On the reverse of the specimen there is an area of granulation tissue which formed the base of an ulcer of the scrotum.

Harry K., æt. 40, was admitted under Mr. Golding-Bird, in 1895, for an enlargement of the left testis associated with ulceration of the scrotum. He had contracted syphilis three years previously, and the swelling of the testis had been observed for two years. The scrotum was tapped, and clear fluid drawn off on four occasions. The ulcer appeared on the scrotum three weeks before admission. The testis was excised, and the patient was discharged relieved three weeks later. See *Surgical Report*, Vol. 179, Case 251.

593 Perforation of the Urethra. Retro-vesical Abscess.

A bladder with the prostatic urethra showing on the floor of the latter a perforation leading into a considerable abscess cavity situated between the bladder and rectum. The neighbouring connective tissue is in a condition of suppurative inflammation.

John C., æt. 18, *See Insp.*, 1896, No. 17.

654 Tuberculous Testis.

A testis with a portion of the scrotum and spermatic cord removed by operation. The testis is somewhat enlarged and contains miliary tubercles. It lies surrounded by a softening caseous mass apparently consisting of tuberculous deposit in the epididymis and in the sac of the tunica vaginalis.

John H., æt. 38, was admitted under Mr. Davies-Colley, in 1896, for a painful swelling of the left testis which had been noticed for three months. Fluctuation was detected, and there was a small sinus over the situation of the head of the epididymis. The testis was excised, and the patient was discharged well seven weeks after the operation. *See Surgical Reports*, Vol. 183, Case 186.

656 Hydrocele of the Spermatic Cord.

A sagittal section through a right testis and the spermatic cord, showing immediately above the testis, and completely shut off from the sac of the tunica vaginalis, a pyriform cyst measuring three inches in length. The wall of the cyst is tough and fibrous, and its lining is rugose. The tunica vaginalis is adherent to the testis except at the upper part.

James H., æt. 56, was admitted under Mr. Davies-Colley, and died five days after the operation of lithotripsy. The patient had worn a truss for some years over a swelling in the right inguinal region, which, on admission, was found to be a hydrocele. *See Insp.* 1896, No. 443.

742 Myxo-sarcoma of the Testis.

The half of a child's testis measuring two and a half inches in length and infiltrated with a white gelatinous growth, which in the recent state presented a few areas of extravasated blood. The organ has a nodulated surface,

and histologically the tumour is a spindle-celled sarcoma with myxomatous degeneration.

From a child, æt. 6, whose mother had noticed a rapidly increasing swelling of the testis for five months before its removal.

Presented by Dr. MOIR, 1897.

810 Cystic Chondro-sarcoma of the Testis.

The half of a testis measuring two and three-quarter inches in diameter, the tissue of which is entirely replaced by a growth which on section presents a convoluted structure and contains numerous cysts. The tunica vaginalis is adherent except over the upper part of the organ. Histologically the growth is a spindle-celled sarcoma containing hyaline cartilage.

Alfred C., æt. 29, was admitted under Mr. Symonds, in 1890, for an enlargement of the left testis, which had been first noticed two months previously. The testis was excised, and the patient was discharged well one month later. *See Surgical Reports*, Vol. 150, Case 69.

999 Strangulation of the Testis.

A testis with the lower end of the spermatic cord mounted to show the gland blackened by extravasated blood, and the cord closely twisted upon itself.

William M., æt. 20, was admitted under Mr. Lucas, in 1891, for a painful swelling in the right groin, which had appeared suddenly three weeks previously. The right testis could not be felt in the scrotum, and the patient stated that it had never occupied its normal position. The swelling was explored and found to consist of the strangulated testis. The organ was removed, and the patient was discharged well three weeks after the operation. *See Surgical Reports*, Vol. 154, Case 191.

1746 Extroversion of the Bladder. Plastic Operation.

An extroverted bladder with the adjacent parts mounted to illustrate the character of a plastic operation performed for the relief of the condition. Flaps were dissected upon either side of the bladder and sewn together, the testes were excised and the penis passed through a hole in the scrotum, the scrotum itself being brought up to complete the anterior wall of the viscus.

James H., æt. 31, was admitted under Mr. Symonds with extroversion of the bladder, for the relief of which a plastic operation was performed four days later. The patient died from cellulitis. At the autopsy the pubic bones were found to be separated from each other for a distance of an inch and a quarter. *See Insp.*, 1892, No. 326.

1759 Blood-tumour in the Bladder.

A female bladder, at the neck of which is seen, on its posterior surface, a rounded elevation a third of an inch in diameter covered by normal mucous membrane, and presenting a slight constriction at its point of attachment. Histological examination shows that the tumour consists of blood-clot lying in the submucous and muscular coats of the organ.

Mary M., æt. 63, was admitted under Mr. Lucas with a strangulated femoral hernia, for the relief of which herniotomy was performed. She died about five weeks after admission, and at the autopsy the mucous membrane of the bladder was of a bright red colour and the kidneys were in a condition of suppurative pyelo-nephritis. *See Insp.*, 1893, No. 228.

1761 Acute Cystitis.

A bladder laid open to show its mucous surface markedly rugose and thickly coated with false membrane. In the recent state it was deeply congested and in parts blackened. On the reverse of the specimen the serous coat of the organ is seen to be covered by a thin layer of lymph. Histological examination shows that the inflammatory process has led to the destruction of the mucous membrane and has affected all the coats of the organ.

Sophia B., æt. 61, was admitted under Mr. Howse for abdominal pain and distension. A catheter was passed and the urine was found to contain pus. Four days later the urine contained blood, and the patient died twelve days after admission. At the autopsy coils of small intestine were found adherent to the bladder, and the kidneys were in a condition of pyelo-nephritis. *See Insp.*, 1892, No. 70, and *Drawing*.

1762 Acute Cystitis.

The urinary organs of a female infant mounted to show the walls of the bladder to be thickened and its interior lined by a false membrane, which can be traced into the lower ends of the ureters. These ducts are considerably dilated, and in the recent state the pelves of the kidneys were reddened and inflamed, and the apices of the pyramids were necrotic.

Mary C., æt. 9 months, was admitted under Dr. Goodhart in a moribund condition. The child had been brought up at a Baby-farm

and was blind in both eyes from corneal opacity. At the autopsy small patches of broncho-pneumonic consolidation were found in the lower lobe of the left lung. *See Insp.*, 1893, No. 56.

1774 Hypertrophied Bladder.

A child's bladder, the cavity of which is of natural size, whilst its wall is hypertrophied so as to measure three-eighths of an inch in thickness. The mucous membrane appears to be healthy.

Charles W., æt. 6, was admitted under Mr. Davies-Colley with symptoms of stone in the bladder. A uric acid calculus weighing thirteen grains was removed by lateral lithotomy. Twelve days later the child died, and at the autopsy the right pleural cavity was found to contain fourteen ounces of fluid, and the lungs were affected with bronchiectasis and lobular pneumonia. *See Insp.*, 1892, No. 135.

1793 Villous Growth in the bladder.

The neck and posterior wall of a bladder mounted to show upon the mucous membrane of the right side two villous tumours, one sessile and the other pedunculated, the latter, which is the larger, being of about the size of a cherry. At the neck of the bladder and in the prostatic urethra are several similar smaller growths. Histologically there is no evidence of malignant disease.

Richard W., æt. 42, was admitted under Mr. Golding-Bird with a malignant growth in the floor of the mouth and died eight days after an operation for its removal. At the autopsy the lower lobe of the left lung was found to be affected by septic broncho-pneumonia, and there were three recent ulcers in the duodenum. *See Insp.*, 1894, No. 292.

1802 Epitheliomatous Tumour of the Bladder.

A bladder laid open by a frontal section to show a globular mass of growth, two and a half inches in diameter, attached by a broad base to the posterior and left lateral walls of the organ. The surface of the growth is ulcerated, and the cut section shows it to have destroyed the muscular coats of the organ. The opening of the left ureter is immediately in front of the tumour. Histologically the growth has the structure of a squamous-celled epithelioma.

John M., æt. 69, was admitted under Dr. Washbourn for abdominal pain and constipation associated with a tense swelling in the left lumbar and inguinal regions. Some years previously he had suffered from hæmaturia and was sounded for stone. On admission the urine

contained pus. The inguinal swelling was incised, and two pints of blood-stained fluid containing pus and urea were withdrawn. He died nine days the operation, and at the autopsy a perinephritic abscess was found communicating with the above-mentioned cavity. The lower portion of the left ureter was dilated and its mucous membrane inflamed. The bladder contained two calculi, and presented evidences of old and recent inflammation. See *Insp.*, 1893, No. 53.

1803 Epithelioma of a Sacculated Bladder.

A bladder with a somewhat enlarged prostate opened from the front, and showing on its left side a sacculus measuring five and a half inches in its longest diameter. The neck of the sacculus, which is nearly three inches across, is infiltrated and greatly thickened by a new growth having a shaggy and villous surface. The growth extends to the anterior wall of the organ and occludes the left ureter. On the reverse of the specimen the left ureter, vas deferens, and vesicula seminalis are seen to lie upon the posterior wall of the cyst. Histologically the growth has the characters of a squamous-celled epithelioma, and the wall of the sacculus is composed of fibrous tissue and has no lining of mucous membrane.

John T., æt. 63, was admitted under Mr. Lucas for hæmaturia, from which he had suffered at intervals for the preceding four months. On admission a swelling was noticed above the pubes to the left of the middle line, extending upwards half-way to the umbilicus. The patient died suddenly four days later, and at the autopsy the right kidney was found to be enlarged and suppurating, the left being hydronephrotic. There were no secondary deposits. See *Insp.*, 1891, No. 474; and *Trans. Path. Soc.*, 1896, p. 155.

1814 Carcinoma of the Bladder.

A portion of a bladder showing around the orifice of the left ureter a lobulated new growth an inch and a half in diameter. The tumour is raised half an inch above the level of the mucous membrane, and its surface has a cauliflower-like appearance. The vertical section shows that the growth is composed of closely-packed villous processes attached to a broad pedicle and invades the muscular coat of the bladder. Histologically the portion of the growth within the muscular coat presents large

alveolar spaces lined with two or three layers of columnar epithelium and filled with large spheroidal cells.

Francis S., æt. 40, was admitted under Mr. Davies-Colley for hæmaturia and cystitis. There was a history of pain on micturition and the occasional passage of blood in the urine during the three years before admission. At the autopsy there was suppurative pyelo-nephritis with chronic tuberculosis of the lungs. *See Insp.*, 1889, No. 399.

1815 Carcinoma of the Bladder.

A bladder mounted to show a uniform infiltration of its walls with malignant growth. The cut section shows that the wall measures as much as an inch in thickness, and that its coats are replaced by a firm white deposit. The interior of the organ is shaggy and ulcerated, and exteriorly the growth forms a large nodular excrescence projecting from the apex on the left side. Histologically the growth has the character of a carcinoma with scanty stroma, most of the epithelial cells being of spheroidal type, whilst a few are large and squamous.

John J., æt. 48, was admitted under Mr. Lucas passing urine which contained pus and blood. Seven months previously an exploratory operation showed that his bladder was infiltrated with malignant growth. He died nine days after admission, and at the autopsy both kidneys were found to contain abscesses, the right being very small and fibrous. *See Insp.*, 1893, No. 233.

1825 Bladder invaded by Sarcoma.

A portion of a bladder mounted to show around the situation of the orifice of the right ureter a flat mass of growth measuring two inches in its longest diameter, and projecting about half an inch above the surrounding mucous membrane. The surface of the growth presents a lobulated appearance, and is in parts superficially ulcerated. On the reverse of the specimen a transverse section through the ureter shows it to be enlarged and completely occluded by a white mass of growth which histologically has the characters of a small round-celled sarcoma.

Edwin O., æt. 54, was admitted under Dr. Pitt with pains in the back, frequency of micturition, and occasional hæmaturia. A nodular tumour was felt in the right lumbar region, and the urine contained pus and blood-stained debris. The patient died twelve days

after admission, and at the autopsy the right kidney was found to be infiltrated by a soft white growth, which invaded the pancreas and the duodenum, and extended down the ureter to the bladder. *See Insp.*, 1897, No. 28.

1826 Bladder invaded by Sarcoma.

A sagittal section through a bladder and rectum showing the former embedded in a mass of firm growth, which in the recent state filled the pelvic cavity. The malignant deposit is seen to infiltrate the muscular coat of the organ, and to appear in the form of flattened nodules beneath the mucous membrane, which is free from ulceration. Histologically the growth is a small round-celled sarcoma containing numerous hæmorrhages.

Robert R., æt. 27, was admitted under Mr. Howse with symptoms of paraplegia and intestinal obstruction. A pelvic growth was detected which gradually extended into the abdomen. The intestinal symptoms were relieved by colotomy, and the patient died about a year from the onset of the disease. At the autopsy secondary deposits were found in the skull, lungs, liver, iliac veins, and peritoneum. There was ascending pyelo-nephritis. It was thought that the primary seat of growth was in the pelvic lymphatic glands. *See Insp.*, 1892, No. 357.

1831 Hydatid of the Bladder.

The male pelvis viscera mounted to show a large hydatid cyst situated between the bladder and the rectum. The cyst is eight inches in vertical measurement and by its extension downwards causes the lower end of the rectum to be separated from the prostate by an interval of four inches. On the right lateral wall of the bladder is seen the orifice of a small sacculus.

Thomas R., æt. 66, was admitted under Dr. Perry with symptoms of hydatids in the liver and peritoneal cavity. He had been in Australia, and for the seventeen years preceding admission had frequently been under treatment for hydatid disease. An incision was made into the sac in the liver, and three weeks later the patient died. At the autopsy hydatids were found in the left lung and in the upper part of the abdominal cavity. *See Insp.*, 1895, No. 151.

LIST

OF

GENTLEMEN EDUCATED AT GUY'S HOSPITAL

WHO HAVE PASSED THE

EXAMINATIONS OF THE SEVERAL UNIVERSITIES, COLLEGES,

&c., &c.,

IN THE YEAR 1896.

University of Oxford.

Final Examination for the Degrees of Bachelor of Medicine and Surgery.

W. Ramsden.

University of Cambridge.

Final Examination for the Medical and Surgical Degrees.

Part I.

A. P. Beddard.	G. B. Muriel.	F. G. Thomas.
J. N. Gardiner.	A. S. J. Pearse.	C. A. Trouncer.
C. E. Michael.	A. E. Porter.	

Part II.

J. N. Gardiner.	T. L. Jackson.	G. B. Muriel.
W. L. Garner.	E. J. Maxwell.	A. S. J. Pearse.
P. R. Lowe.	W. Tyson.	F. G. Thomas.

Second Examination for the Medical and Surgical Degrees.

Part I.

J. H. Roberts.

Part II.

H. A. Gaitskell.		E. C. Taylor.
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Examination in Sanitary Science.

H. W. Beach.		W. C. Q. Pakes.		A. J. Sharp.
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University of London.

Examination for the Degree of Doctor of Medicine.

[L. E. V. Every-Clayton		W. S. Handley.		G. S. Hovenden.
		L. A. Parry.		

A. Salter (*obtained the Gold Medal*).

Examination for the Degree of Master in Surgery.

J. St. T. Clarke.		J. W. F. Jewell.		T. M. Thomas
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Examination for the Degree of Bachelor of Surgery.

Second Division.

N. H. Pike.		A. H. Spicer.
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Examination for the Degree of Bachelor of Medicine.

May.

Second Division.

N. Instone.		H. Nolan.		H. M. Wise.
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October.

Second Division.

N. H. Pike.

Obtained Honours in Medicine and in Obstetric Medicine.

A. H. Spicer.

Obtained Honours in Medicine, Obstetric Medicine, and in Forensic Medicine

E. Ivens Spriggs.

Obtained Honours in Forensic Medicine.

A. G. Butler.		E. T. Scowby.
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Intermediate Examination in Medicine.

January.

Entire Examination.

Second Division.

K. B. Alexander.	|	R. Balderston.	|	H. L. Eason.
		J. A. Glover.		

Excluding Physiology

Second Division.

H. E. C. Fox.		E. C. B. Ibotson.		G. Chetwode-Owsley.
		E. E. Parrett.		

Physiology only.

Second Division.

L. E. C. Handson.		W. L. Stuart.
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July.

Honours Examination.

C. T. Hilton.

Obtained the Exhibition and Gold Medal in Materia Medica and Pharmaceutical Chemistry, First Class Honours in Physiology and Histology, and Honours in Anatomy and in Organic Chemistry.

D. J. Munro.

Obtained Honours in Organic Chemistry.

Pass List.

Entire Examination.

First Division.

R. H. J. Swan.

Second Division.

F. W. Brook.
A. E. Clarke.

J. T. Dunston.
J. Matthews.
F. D. Turner.

A. G. Osborn.
A. G. G. Plumley.

Excluding Physiology.

Second Division.

A. H. Carter.

A. Densham.

W. B. Secretan.

Physiology only.

Second Division.

D. L. Smith.

Preliminary Scientific (M.B.) Examination.

January.

Chemistry and Experimental Physics.

F. G. Gibson.
J. A. B. Hammond.

A. D. E. Kennard.
T. A. Matthews.
K. V. Trubshaw.

L. C. A. Savatard.
F. M. Vincent Smith.

Biology.

F. A. Beattie.
G. B. F. Churchill.
G. Evans.

D. Forsyth.
H. K. Lacey.
D. L. Morgan.

A. Pearson.
H. Tattersall.
F. C. Wetherell.

July.

Entire Examination.

First Division.

H. F. Hatfield.

Second Division.

W. J. Davies.

C. Noël Davis.
C. Tessier.

L. E. Stamm.

Chemistry and Experimental Physics.

V. A. Chatelain.
G. T. Collins.

M. A. Collins.
A. C. H. Gray.
F. L. Thomas.

H. C. Keates.
W. G. Parker.

Biology.

H. W. Brown.	A. D. E. Kennard.	M. J. Rees.
F. G. Gibson.	G. H. H. Manfield.	L. C. A. Savatard.
E. T. Kendon.	T. A. Matthews.	F. M. Vincent Smith.
	D. H. Trail.	

Intermediate Examination in Science.

Second Division.

J. A. B. Hammond.

University of Durham.

Examination for the Degree of Doctor of Medicine for Practitioners of Fifteen Years' standing.

J. Davies.

Final Examination for the Degree of Bachelor of Medicine.

April.

T. B. Poole. | F. W. Rowland.

Obtained Honours.

H. M. Meyrick-Jones.

September.

V. Pendred. | W. E. Rudd.

Final Examination for the Degree of Bachelor in Surgery.

April.

H. M. Meyrick-Jones. | T. B. Poole. | F. W. Rowland.

Second Examination for the Degree of Bachelor of Medicine.

April.

V. Pendred.

Obtained Honours.

September.

J. Harris. | A. Ayre Smith.

First Examination for the Degree of Bachelor of Medicine.

Elementary Anatomy, Chemistry and Physics.

H. Braund. | F. D. Welch.

Chemistry and Physics.

E. H. Barlow.	V. Pendred.	A. M. Thomas.
J. Harris.	A. Ayre Smith.	

Anatomy.

F. W. Sime.

Royal College of Physicians.*Admitted to the Membership.*

T. G. Stevens. | G. F. Still.

Final Examination for the License.

January.

H. Alexander.	S. G. Graham.	J. B. Parfitt.
H. T. S. Bell.	W. P. Gwynn.	N. H. Pike.
L. Bensted.	J. Howell.	T. B. Poole.
J. W. Bird.	H. E. Izard.	J. C. G. Reed.
A. G. Butler.	T. L. Jackson.	J. Robertson.
A. V. Chapman.	E. P. H. Lulham.	F. W. Rowland.
J. J. Culmer.	A. J. Mathison.	H. J. Spon.
N. Daly.	R. O. Moon.	C. E. S. Watson.
A. J. Dolman.	T. M. Nicholson.	

April.

F. J. H. Cann.	B. B. Ham.	B. A. Richmond.
A. V. Clarke.	R. Hedden.	R. L. Roberts.
C. Coventry.	A. R. Hitchfield.	M. Hamblin Smith.
J. W. Culmer.	S. Infield.	A. H. Spicer.
W. L. B. Davies.	H. J. M. Milbank-	T. W. Stanton.
E. Fisk.	Smith.	C. C. Stead.
C. H. Flory.	G. B. Muriel.	E. H. Tipper.
J. J. Foster.	B. F. Pendred.	P. N. Vellacott.
W. L. Garner.	W. E. Plummer.	

July.

A. Alexander.	N. Lavers.	J. Robertson.
C. T. Anderson.	D. A. W. Martin.	R. P. Rowlands.
R. T. Brown.	R. Mathias.	R. Serjeant.
C. G. Burton.	A. W. Ormond.	D. W. Thomas.
C. H. Fagge.	A. S. J. Pearse.	W. C. P. Winter.
W. W. Farnfield.	F. R. Proctor-Sims.	R. G. Worger.
A. J. Greene.	W. M. Price.	
T. John.	E. S. Roberts.	

October.

V. E. Collins.	W. L. T. Goodridge.	C. Jephcott.
W. T. Clarke.	W. J. Hancock.	G. K. Levick.
R. E. Delbruck.	F. H. Hardy.	W. H. Moore.
A. Earnshaw.	W. W. Henson.	D. L. Smith.
A. H. Finch.	H. T. Hicks.	D. B. Todd.
J. N. Gardiner.	W. E. Hills.	A. Scott Turner.
	W. R. Wood.	

Royal College of Surgeons.*Final Examination for the Fellowship.*

C. H. Bryant.	H. A. Moffat.	A. J. Sharp.
H. Davies.	L. A. Parry.	F. J. Steward.
L. E. V. Every-Clayton.	V. Pendred.	E. C. Taylor.

First Examination for the Fellowship.

T. P. Berry.	L. H. McGavin.	E. C. Taylor.
H. A. Duffett.	V. Pendred.	W. H. M. Telling.
A. H. Godson.	S. A. Ruzzak.	P. N. Vellacott.
C. W. Hewlett.	F. J. Steward.	F. E. Walker.

Final Examination for the Membership.

January.

H. Alexander.	S. G. Graham.	J. B. Parfitt.
H. T. S. Bell.	W. P. Gwynn.	N. H. Pike.
L. Bensted.	J. Howell.	T. B. Poole.
J. W. Bird.	H. E. Izard.	J. C. G. Reed.
A. G. Butler.	T. L. Jackson.	J. Robertson.
A. V. Chapman.	E. P. H. Lulham.	F. W. Rowland.
J. J. Culmer.	A. J. Mathison.	H. J. Spon.
A. J. Dolman.	T. M. Nicholson.	C. E. S. Watson.

April.

F. J. H. Cann.	B. B. Ham.	B. A. Richmond.
A. V. Clarke.	R. Hedden.	R. L. Roberts.
C. Coventry.	A. R. Hitchfield.	M. Hamblin Smith.
J. W. Culmer.	S. Infield.	A. H. Spicer.
W. L. B. Davies.	H. J. M. Millbank-	T. W. Stanton.
E. Fisk.	Smith.	C. C. Stead.
C. H. Flory.	G. B. Muriel.	E. H. Tipper.
J. J. Foster.	B. F. Pendred.	P. N. Vellacott.
W. L. Garner.	W. E. Plummer.	

July.

A. Alexander.	N. Lavers.	J. Robertson.
C. T. Anderson.	D. A. W. Martin.	R. P. Rowlands.
R. T. Brown.	R. Mathias.	R. Serjeant.
C. G. Burton.	A. W. Ormond.	D. W. Thomas.
C. H. Fagge.	A. S. J. Pearse.	W. C. P. Winter.
W. W. Farnfield.	W. M. Price.	R. G. Worger.
A. J. Greene.	F. R. Proctor-Sims.	
T. John.	E. S. Roberts.	

October.

V. E. Collins.	W. J. Hancock.	G. K. Levick.
W. T. Clarke.	F. H. Hardy.	W. H. Moore.
R. E. Delbruck.	W. W. Henson.	D. L. Smith.
A. Earnshaw.	H. T. Hicks.	D. B. Todd.
A. H. Finch.	W. E. Hills.	A. Scott Turner.
J. N. Gardiner.	C. Jephcott.	W. R. Wood.
W. L. T. Goodridge.		

Final Examination for the License in Dental Surgery.

E. Ashby.	J. E. Dupigny.	W. J. M. Lacey.
E. D. Bascombe.	R. G. Edey.	G. Naish.
L. Bidlake.	G. G. Ellis.	N. H. Oliver.
W. W. Briant.	S. J. Evans.	A. G. G. Plumley.
G. Chatterton.	K. W. Goadby.	A. Read.
E. Coltman.	T. D. E. Goodman.	G. S. Simpson.
H. C. Cowles.	H. V. W. Harris.	N. Snell.
H. S. Crapper.	E. E. D. Heesom.	R. H. Stevens.
A. E. B. Crosby.	C. J. Hinchliff.	L. Ta'Bois.
A. de Mierre.	L. S. Hounsell.	R. G. Tasker.
A. M. Donston.	A. F. Howe.	E. R. Tebbitt.
N. Doyle.	C. H. Knowles.	

MEDALLISTS AND PRIZEMEN.

JULY, 1897.

The Treasurer's Gold Medal for Clinical Medicine.

Robert Pugh Rowlands, Towyn, N. Wales.

The Treasurer's Gold Medal for Clinical Surgery.

Robert Howard, Buckhurst Hill.

Golding-Bird Gold Medal and Scholarship for Sanitary Sciences.

Alfred Salter, Blackheath.

Bertie Burnett Ham, Victoria, Australia. (Proxime Accessit.)

Beaney Prize for Pathology.

Robert Howard, Buckhurst Hill.

Robert Pugh Rowlands, Towyn, N. Wales. (Proxime Accessit.)

Richard Bredin Prize for Clinical Study.

Robert Pugh Rowlands, Towyn, N. Wales.

Michael Harris Prize for Anatomy.

Percy William Leopold Camps, Islington, Prize, £10.

James Alfred Butler, Brixton, Certificate.

William Howard Edwards, Streatham, Certificate.

Wooldridge Memorial Prize in Physiology.

John Ford Northcott, South Hampstead, Prize, £10.

Ernest Alfred Miller, Upper Norwood, Certificate.

*The Arthur Durham Prizes for Dissection.**First Year's Students.*

George Thomas Willan, Melton Mowbray, Prize £5.

Louis Edward Stamm, Redhill	} equal Certificates.
Claude Tessier, Sevenoaks	

Second Year's Students.

Frederick Curtis, Staines, Prize £15.

Hugh Kirbell Lacey, Woolwich, Certificate.

The Hilton Prize for Dissection.

Arthur Ronald McLachlan, Brighton, Prize, £5.

Fourth Year's Prizes.

Philip Turner, Earl's Court Gardens, Prize, £25.

Harold Wilson Bruce, Bow, £5.

William Tayler Milton, Blackheath, £5.	} equal.
Charles Leopold Granville Chapman, Grimsby	

George Ernest Richmond, Leicester	} equal Certificates

Second Year's Prizes (1896).

Caleb Thomas Hilton, Newton-le-Willows, Prize, £25.

Graham Scales Simson, Brighton, Second Prize, £10.

First Year's Prizes (1896).

William Howard Edwards, Streatham, £37 10s.
 Ernest Alfred Miller, Norwood, £37 10s.
 James Alfred Butler, Brixton, Certificate.

*Dental Students.**Second Year's Prizes (1896).*

Kenneth Weldon Goadby, Reading, Prize, £15.
 Guy Chatterton, Peckham Rye, Certificate.
 George Garnett Ellis, Southsea, Certificate.

First Year's Prizes.

Percival Sidney Campkin, Cambridge, Prize, £10.
 Harry Hudson Evans, Abergavenny, Certificate.

Practical Dentistry Prize.

Henry Albert Ellis Canning, Market Lavington, £10.
 Alfred William Walker, Stonegate, Certificate.

Open Scholarships in Arts.

William Edward James Tuohy, Bedford, £100.
 Albert Herbert Edwin Wall, Highgate, £50.
 Lorimer Gifford Nash, Bampton, Certificate.

Dental Students.

Archibald James Gwatkin, Brighton, £30.

Open Scholarships in Science.

Myer Coplans, Canterbury, £150.
 John Ford Northcott, South Hampstead, £60.
 Frank Shufflebotham, Newcastle-under-Lyne, Certificate.
 Henry Crew Keates, Petersfield, Certificate.

Physical Society.*Session 1897-8.*

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Honorary Secretaries.—J. H. Targett, M.S., J. H. Bryant, M.D.

PRIZEMEN FOR THE SESSION 1896-7.

Mr. F. E. Fremantle, First Prize £10, for his paper on "Castration for Enlarged Prostate."

Mr. S. E. Denyer, Second Prize, £5, for his paper on "The Histology of Mammary Carcinoma."

Mr. A. W. Ormond, The Treasurer's Prize, £5, for his paper on "Glaucoma."

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J. Harris.	H. S. Turner.	T. M. Walker.

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N. Lavers.	C. P. Weekes.	W. E. Hills.
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H. Durbridge.
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C. R. Nicholson.

W. Tyson.
F. A. Godson.
F. C. Hitchins.
A. J. Wernet.
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A. C. Ambrose.	A. J. Hull.	J. Moore.
S. Whicher.	H. S. Turner.	W. T. Milton.
C. E. Hibbard.	H. P. W. Barrow.	G. H. Bedford.
L. Humphry.	F. A. Godson.	J. A. Glover.
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J. Robertson.	A. G. Butler.	H. W. Dudgeon.
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C. W. Booker.	A. H. Spicer.	A. E. Porter.

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F. J. H. Cann.	S. C. Clapham.	

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A. B. Carter.	H. W. Dudgeon.	P. W. Moore.
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G. G. Ellis.	E. C. Brown.	H. R. Pratt.

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H. R. Pratt.	C. E. Brown.	C. A. Wilson.
P. H. Cook.	W. Floyd.	R. G. S. Holmes.
A. D. Hopkins.	S. R. Redpath.	B. J. Sumerling.

ASSISTANT DEMONSTRATOR OF DENTAL MICROSCOPY.

K. W. Goadby.

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C. Lee.	W. Willmore.	F. Ward.
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P. Nathan.	D. P. Tracey.	P. S. Campkin.
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G. Naish.	C. H. Knowles.	C. N. Doyle.
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G. D. Slater.	H. Knight.	A. St. J. Styer.
R. G. S. Holmes.	C. E. Brown.	D. G. Worts.
A. Cooper.	E. B. Dowsett.	S. J. Evans.
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C. Lee.	G. Marshall.	W. Floyd.
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A. O. Bell.	T. W. Bromley.	H. A. E. Canning.
J. M. P. Crombie.	H. A. G. Butler.	

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L. Ta'Bois.	S. W. Cock.	J. M. P. Crombie.
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1897.

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Obstetric Registrar and Tutor.

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Ophthalmic Registrar and Tutor.

G. BELLINGHAM SMITH, B.S.

Warden of the College.

MR. DUNN.

Lying-In Charity.

DR. GALABIN AND DR. HORROCKS.

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DR. SHAW.

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<i>Clinical Surgery</i>	THE SURGEONS AND ASSISTANT SURGEONS.
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<i>Surgery</i>	MR. HOWSE AND MR. DAVIES-COLLEY.
<i>Practical Surgery</i>	MR. FAGGE.
<i>Operative Surgery</i>	MR. DUNN.
<i>Midwifery and Diseases of Women</i> ...	DR. GALABIN.
<i>Practical Obstetrics</i>	DR. HORROCKS.
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<i>Diseases of the Throat</i>	MR. SYMONDS.
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<i>Anæsthetics</i>	MR. TOM BIRD AND MR. ROWELL.
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For Prospectus and further information, apply to the Dean, Dr. SHAW Guy's Hospital, London Bridge, S.E.

GUY'S HOSPITAL.

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J. H. BADCOCK, L.R.C.P., M.R.C.S., L.D.S.E.

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List of Pupils who have received Appointments at Guy's Hospital, 1895.

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